British Red Cross Society First-Aid Manual

No. 1

By

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Hon. Surgeon-Colonel, R.A.M.C. (T.F.)

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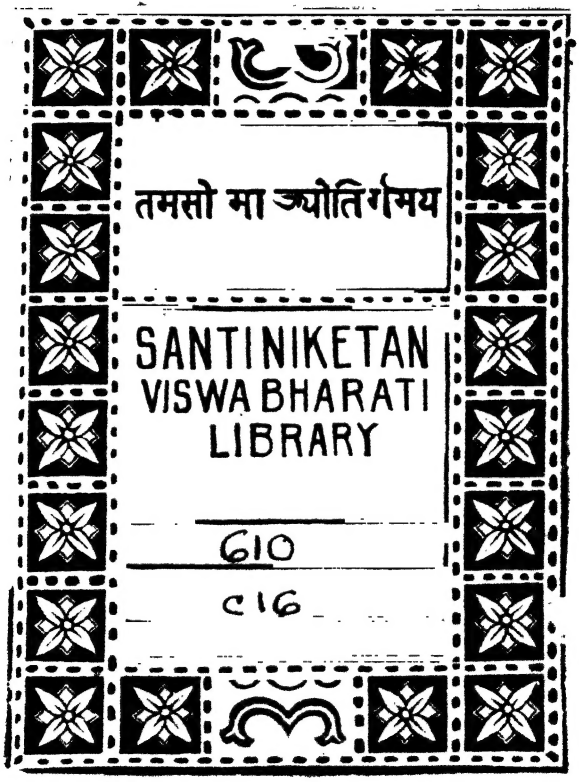

THE

British Red Cross Society

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THE British Red Cross Society is the outcome of the fusion of the late "British National Society for Aid to the Sick and Wounded in War," which was founded by that gallant soldier the late Lord Wantage, V.C., and the "Central British Red Cross Council," his late Majesty King Edward VII. having considered it desirable that the Red Cross Movement in the Empire should be represented by one Society, which should co-ordinate all such associations as are concerned with the succour of the sick and wounded in war.

The Society was inaugurated at a meeting held at Buckingham Palace on the 17th of July, 1905, under the presidency of her Majesty Queen Alexandra.

The Society was granted by his late Majesty a

Royal Charter of Incorporation by Letters Patent under the Great Seal on the 3rd of September, 1908.

The work of the Society in the United Kingdom is organised and carried out mainly through the medium of County Branches, the President of each respective branch being the wife of the Lord Lieutenant, or some person nominated by him. The President of every respective Colonial Branch is the Governor, or some person appointed by him.

The primary object of the Society is to furnish aid to the sick and wounded in time of war. Such aid must necessarily be supplementary to that provided by the Medical Departments of the Navy and Army. It is assumed that upon those two departments rests the responsibility of providing for the casualties of war, and the Society only professes to offer such additional comforts and such general help as may be considered beyond the reasonable scope of the official bodies.

The Admiralty and War Office have accorded their official recognition to the British Red Cross Society as the organisation responsible for the Red Cross movement throughout the Empire, and have agreed that in time of war all voluntary offers of assistance made in Great Britain and Ireland shall reach them only through the channel of the Society, other than those coming from or already arranged with, the Ambulance Department of the Order of St. John and the St. Andrew's Ambulance Association for the supply of certain personnel.

It is a further object, therefore, of the British Red Cross Society to examine, systematise, and co-ordinate all offers of help, and, by preventing waste and overlapping, to render them of the utmost possible value.

Since the inception of the original Society in 1870 to the present year, 1912, a sum of nearly £500,000 has been expended by the Society in assisting the

sick and wounded in war. Of this large sum £162,296 was expended in aid of the sick and wounded during the South African War, 1899–1902.

The Secretary of State for War issued on August 16th, 1909, to Territorial Force Associations in England and Wales, a "Scheme for the Organisation of Voluntary Aid for Sick and Wounded," in the event of war in the Home Territory. Full details of this scheme are contained in the Society's Form D.

In this "scheme" a county system has been adopted because it is the one upon which the Territorial Force is organised, and which the British Red Cross Society has adopted as the basis of its constitution; and the Society is the body recommended by the War Office to the Territorial Force Associations for the carrying out of this important work.

The Medical Service of the Territorial Force has no establishment for carrying out the duties in connection with (*a*) Clearing Hospitals, (*b*) Stationary Hospitals, (*c*) Ambulance Trains, and (*d*) other formations, viz. Entraining and Rest Stations, Private Hospitals, and Convalescent Homes.

In order to provide a personnel that will be available for any or all of the duties indicated, Voluntary Aid Detachments are organised in each county, consisting respectively of men and women, as follows:—

MEN'S DETACHMENT.

1	Commandant.
1	Medical Officer.
1	Quartermaster.
1	Pharmacist.
4	Section Leaders.
48	Men (divisible into four sections of 12 men each).
Total 56	

WOMEN'S DETACHMENT.

1 Commandant (man or woman, and not necessarily a Doctor).
1 Quartermaster (man or woman).
1 Trained Nurse as Lady Superintendent.
20 Women, of whom 4 should be qualified as cooks.

Total 23

Each detachment as it is formed and approved is registered by the Council of the British Red Cross Society, is given a consecutive number by the War Office, and forms part of the Technical Reserve, and is inspected annually by an Inspecting Officer detailed by the War Office.

The Society's uniform may be optionally worn by members of detachments, and the regulations in regard thereto are included in the Society's Form D (7).

The War Office having approved the certificates granted by the Society in First Aid and Nursing, the Red Cross Branches are empowered to form classes and hold examinations in these subjects, in order to qualify candidates who do not already possess such certificates for admission to detachments. (For details, *see* Form D (4)).

The **Men's Detachments** must be thoroughly trained as stretcher bearers, and to some extent as male nurses. A certain proportion of clerks, carpenters and mechanics would be especially useful. The principal duties of the personnel would consist in carrying sick and wounded by stretchers, and, when necessary, in preparing means of transport by road or rail, in converting local buildings or whole villages into temporary hospitals, and in disinfecting buildings, etc.

The **Women's Detachments** would be employed chiefly in forming Railway Rest Stations for preparing and serving meals and refreshments to sick and wounded during transit by railway, and in taking temporary charge, in the evacuation stations or temporary hospitals, of severe cases unable to continue the journey. They should, therefore, be trained not only in cooking and the preparation of invalid diets, but also in the method of arranging small wards for patients in suitable buildings, preferably near a railway station, and in such nursing as is necessary for the temporary care of patients until they can be transferred to the general hospitals. Detachments, or a certain portion of a detachment, may be employed for duty in ambulance trains.

Each member of a detachment when called up for service will be provided with an identity certificate and a "brassard" or arm badge bearing the Geneva Cross. The identity certificate and brassard will be issued by a responsible officer of the Army. The wearer of the brassard so issued is "protected" under the articles of the Geneva Convention.

It may be mentioned that enrolment as a member of a Red Cross Voluntary Aid Detachment does not render such individual a member or associate of the British Red Cross Society. The conditions for admission as such are detailed in Form A, copies of which may be obtained from the Society's offices.

Since the publication of the above "Scheme" the British Red Cross Society has been very active in the organisation of Voluntary Aid Detachments, and by the 31st of March, 1912, the Society had raised, and registered at the War Office, 1,208 Red Cross detachments with the total personnel of 35,772.

By the Geneva Convention Act, 1911, "it shall not be lawful for any person to use for the purposes of

his trade or business, or for any other purpose whatsoever, without the authority of the Army Council, the heraldic emblem of the red cross on a white ground formed by reversing the Federal colours of Switzerland, or the words 'Red Cross' or 'Geneva Cross.'"

The British Red Cross Society has the authority of the Army Council to use the heraldic emblem of the red cross and the words "Red Cross."

The official badge of the Society, with the emblem of the Society as a circular pendant attached to an ornamental bar lettered with the name of the respective county, may be worn on the left side by those who belong to any branch of the Society or its Voluntary Aid Detachments so long as a connection with the branch is maintained. This badge is only issued, in accordance with the Society's regulations, on the nomination of its branches.

Detailed information of the organisation and objects of the Society may be obtained on application to the Secretary,

FRANK HASTINGS,

9, Victoria Street, London, S.W.,

to whom all communications should be addressed.

PREFACE

THIS Manual is No. 1 of the series of three which I have prepared at the request of the Council of the British Red Cross Society, No. 2 being the Nursing Manual and No. 3 the Training Manual. An exact knowledge of what to do in emergencies, whether arising from accident or from illness, is a necessary part of the teaching of those intending to take up the work with the Red Cross under the War Office scheme for the Organisation of Voluntary Aid.

Instead of bringing out one manual dealing with surgical emergencies, nursing, and systematic training for field work, it was considered imperative that separate textbooks should be devoted to each branch of Red Cross training, so that members might attain proficiency in each department of the subject before proceeding to the next.

A thorough acquaintance with the contents of the No. 1 Manual is the basis of all Red Cross work. The Council of the Society, in order to encourage the acquisition of this knowledge, has decided that for every re-examination passed in the subjects dealt with in No. 1

or No. 2 of this series, a bar shall be added to the ribbon granted to the members of Red Cross detachments, in conformity with the regulations given at p. 197.

The methods of lifting and carrying patients are merely touched upon in this Manual, as these subjects are dealt with fully in No. 3 of the series.

That this textbook may be of real help to those whose patriotic aim it is to prepare themselves to render efficient help to the Red Cross in its beneficent mission to the sick and wounded, is the author's earnest desire.

JAMES CANTLIE.

February, 1912.

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CHAPTER I

INTRODUCTORY

For descriptive purposes, the body is assumed to be in the erect (standing) position, facing the student, with the upper limbs hanging by the sides and the palms of the hands directed forwards (Fig. 1, anterior aspect).

Terms in Common Use

Central Axis.—An imaginary line drawn from the top of the head straight downwards through the trunk and between the lower limbs to the heels marks the centre (middle line or axis) of the body (Fig. 1, anterior aspect).

Internal and External.—When any structure is situated nearer this line than its neighbour, the former (the nearer) is said to be *internal* to the latter, and the latter (the outer or farther away from the middle) *external* to the former. Thus, the part of the thigh nearest this line is the inner or internal part of the thigh, and the part of the thigh farthest away from the central line is the outer or external part of the limb (Fig. 1, anterior aspect). In the same way the little finger, when the hand is held with the palm forwards, is said to be on the inner or internal side of the hand, and the thumb on the outer or external aspect of the hand.

Anterior and Posterior.—The front of the body is termed the *anterior* aspect, the back the *posterior* or *dorsal* aspect, the side the *lateral* aspects (Figs. 1 and 2). In the same way, when one structure is placed nearer the front of the body than another it is said to be anterior to its neighbour, and when a structure is

nearer the back of the body than its neighbour it is said to be posterior to it. Thus in the leg we have an anterior and posterior group of muscles, and an anterior and posterior artery, the tibials.

Superior and Inferior.—With the body in the erect position, it is readily understood that when one structure is above another it is said to be *superior* to

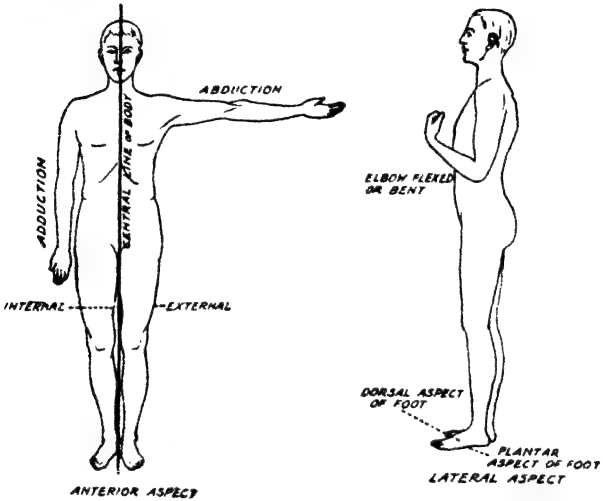


Fig. 1.—Anterior and lateral aspects of the body.

its neighbour, and *inferior* if below it; thus the chest is superior to the abdomen, the upper or dorsal aspect of the foot is superior to the under aspect (the sole), and so forth.

Prone and Supine.—When the body is lying face downwards it is said to be in the *prone* position, and when lying on the back, in the *supine* position.

Dorsal.—The word dorsal (dorsum = the back) is in frequent use. The back itself is termed the dorsal region of the body. The back of the hand is technically called the dorsum or dorsal aspect of the hand,

and the upper aspect of the foot the dorsum of the foot (Fig. 1, lateral aspect).

In whatever position the body is placed, whether

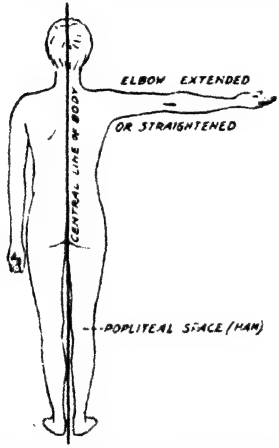


Fig. 2.—Posterior aspect of the body.

lying, standing, or sitting, or even when inverted, the terms superior and inferior, anterior and posterior, have the meaning referred to above.

Flexion and Extension, Adduction and Abduction. —*See* p. 25.

CHAPTER II

THE SKELETON

The Bones.—The bones constitute a framework or **skeleton** on which the body is built (Fig. 3). As met with in a skeleton, the bones represent merely the dry, mineral or earthy portions of which the bones are composed. The living parts, e.g. the blood-vessels, the nerves, the fat, the gelatin and the membranes present in the living bones have disappeared; the bone salts, composed largely of lime, are all that is left of the skeleton as we see it in museums and lecture rooms.

The structure and parts of a bone will be best understood by examining one of the long bones of the limbs, say the thigh-bone. On taking a vertical or a transverse section of the thigh-bone (Figs. 4 and 4a) it will be seen (*a*) that the centre is the cavity for the marrow, (*b*) that around this space and filling the extremities of the bone is a mass of honeycombed-looking (*cancellous*) tissue presenting a number of small cells or spaces which communicate with each other. Outside the cancellous material, and constituting the surface of the dry bone is a hard dense material known as the *compact* tissue, which occurs as a thick layer in the centre of the bone, and tapers off into a thinner layer towards the extremities of the bone above and below. In the living bone the hollow in the centre is filled with a fatty material, the marrow (*medulla*); hence the hollow in the centre is termed the medullary cavity. On the surface of the living bone a membrane (*periosteum*) richly endowed with blood-vessels serves to give nourishment to the bone, favours its growth in the young, and provides bony material to unite the bone when it is broken. In other bones, such as the vertebræ, the ribs, the bones of the hand and foot, the skull, and several others, there are no cavities or

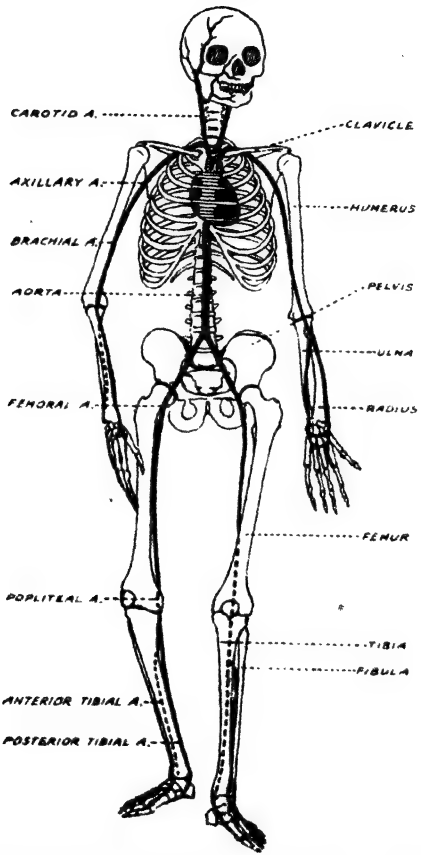


Fig. 3.—Outline of the skeleton, anterior aspect, with the main arteries.

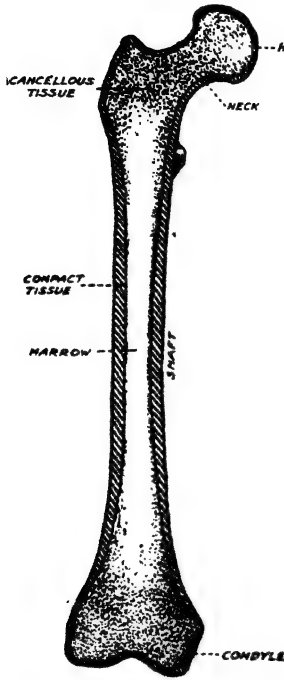


Fig. 4.—Vertical section of the thigh-bone (femur).

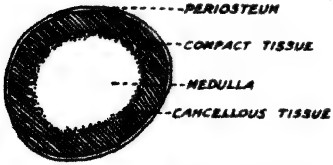


Fig. 4a.—Transverse section of the thigh-bone.

medulla in the centre; each consists of a surface lining of compact tissue with cancellous tissue in the centre.

In dealing with the bones of the body *seriatim* it is best to commence with the spine, as the spinal column forms the foundation upon which the trunk and the limbs are built.

Spine or Vertebral Column

The spine or backbone, or as it is technically termed the vertebral column, consists of a number of bones arranged to form a long column which extends from the base of the skull to the lower part of the trunk. Each bone of the spine is termed a **vertebra.**

The vertebral column is apportioned into five regions (Fig. 5).

1. The **cervical** or neck region is composed of seven bones which constitute the neck vertebræ. The first, or uppermost vertebra, from the fact that it supports the skull, is termed the *atlas*; between the skull and atlas the

nodding movements of the head take place. The second bone is named the *axis*, and between the atlas and axis the side to side movements of the head take place. The last, or seventh, cervical vertebra, from the fact that its spine protrudes prominently beneath the skin at the root of the neck behind, is called the *prominent vertebra* (*vertebra prominens*).

2. The **dorsal** or back region consists of twelve vertebræ, which support the twelve pairs of ribs. On their sides and transverse processes, surfaces on which the ribs rest distinguish the dorsal from the other vertebræ (Fig. 6).

3. The **lumbar** or loin region is made up of five bones which by their size serve to constitute the main support of the trunk.

4. The **sacral** or rump region differs from those previously mentioned inasmuch as the five bones of which it is primarily composed in the child are fused together in the adult to constitute a single bone, termed the *sacrum* or rump-bone.

5. The **coccygeal** or tail region primarily consists in the child of four separate bones, but in the adult it is met with as a single bone and termed the *coccyx* or tail-piece of the vertebral column.

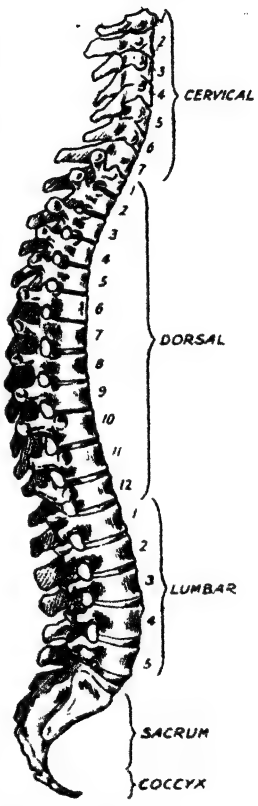


Fig. 5.—The vertebral column, side view.

In all, there are thirty-three bones in the spine.

Reference to Fig. 5 will show that the vertebræ from the first cervical to the fifth lumbar, as a rule, increase in size; this is in keeping with the increasing weight that the bones have to support as the lower part of the spine is reached. As at the sacrum the weight of the body is transmitted to the pelvis, and thence to the lower limbs, the vertebræ diminish in size so that the sacrum and coccyx taper towards their lower ends. The diagram also shows that the spine is curved; in the region of the neck it is curved slightly forward; in the region of the back it is curved backward; in the lumbar region the curve is again forward; in the sacral and coccygeal regions the curve is sharp, so that it presents a concavity in front towards the pelvis, and behind a hard convex ridge of bone appropriately termed the rump.

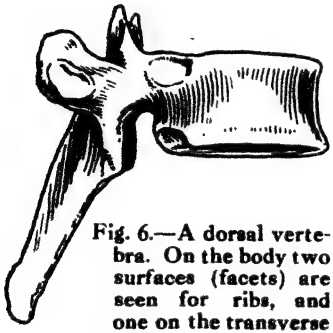


Fig. 6.—A dorsal vertebra. On the body two surfaces (facets) are seen for ribs, and one on the transverse process.

The component **parts of a vertebra** will be best illustrated by taking one of the bones of the lumbar region as a type. This bone (Fig. 7) presents a large mass in front which constitutes the *body* of the bone and serves to support the weight of the trunk. Projecting backwards are bony *processes* which meet behind and enclose a space termed the *spinal canal.* On either side *transverse processes* are seen, and behind is a single process, the *spinous process*, which can readily be felt beneath the skin of the back.

The **spinal canal** consists of a channel extending throughout the entire length of the column, and serves to protect and give passage to the spinal cord and the nerves proceeding from it. The nerves find their exit from the canal by apertures between the vertebræ; a pair of nerves, one on either side, being given off be-

tween two vertebræ throughout the entire length of the spine.

Between the vertebræ in the neck, the back, and the loins, masses of gristle (cartilage) are interposed, termed **intervertebral discs,** which serve as buffers to break shock and at the same time to bind the bones together into a long flexible column. In the sacrum and coccyx discs of cartilage are present in the child,

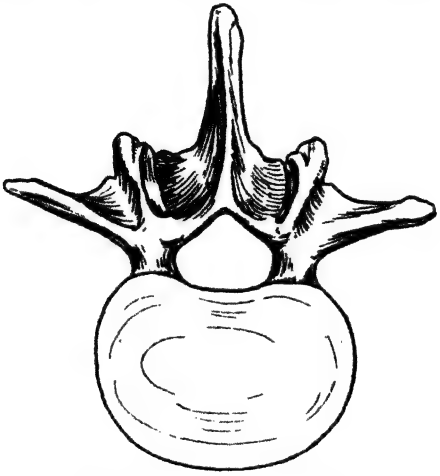


Fig. 7.—A lumbar vertebra.

but they disappear in the adult owing to the bones of these regions being joined into a single bone.

The Pelvis

At the lower part of the trunk a large basin or girdle of bone, the pelvis (Figs. 8, 9, 10) exists for the support of important organs within its area, while the outer side presents a cavity (**acetabulum**) for the reception of the head of the thigh-bone to form the hip-joint, and wide surfaces which afford attachment to muscles of the lower limbs. The pelvis consists of three parts: behind are

the **sacrum** (rump-bone) and **coccyx** (tail-bone), and in front and on either side two large irregular bones—the **haunch** or **innominate bones**—complete the walls of the basin. Each haunch or innominate bone in the adult consists of only one piece, but in the child three parts are in evidence separated by cartilage, which in the adult is replaced by bone, so that the three pieces are cemented into one. Of these three pieces the upper

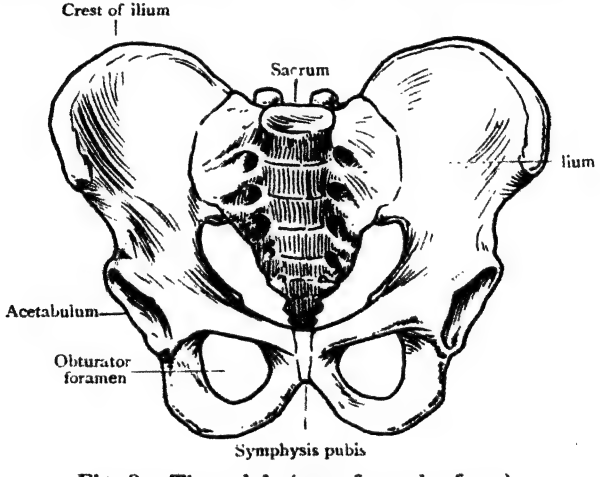


Fig. 8.—The pelvis (seen from the front).

or flat curved portion is named the *ilium;* the lower part presents the rounded prominence on which one sits, and is termed the *ischium;* the portion in front meets its fellow of the opposite side, but with a piece of cartilage intervening, and is termed the *pubes.* The highest point of the haunch-bone is named the *crest* (of the ilium). It is readily felt beneath the skin reaching from the outer part of the groin round the side to the back. It ends in front in a prominent knob—the spinous process of the ilium.

The **cavity** of the pelvis consists of an upper and a

lower portion; the upper is termed the *false* pelvis, and the lower the *true* pelvis; each contains or gives support to important abdominal organs.

The junction of the false and the true pelvis is marked by a ridge, the "brim of the pelvis." The gap left between the bones on either side in front is the obturator foramen (aperture); it is closed by a stout membrane.

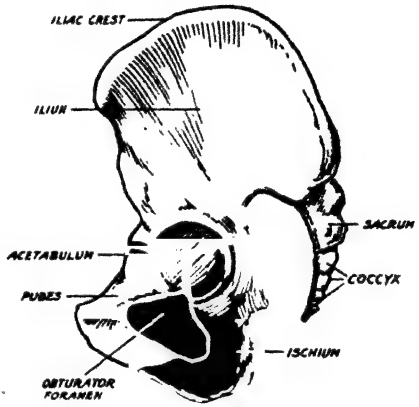


Fig. 9.—Haunch-bone of a child, showing cartilage between the component parts.

The pelvis presents three **joints** (practically immovable), cartilage intervening between the bones. Two joints are behind where the haunch (innominate) bones meet the rump-bone (sacrum), and one joint in front, where the meeting is known as the *symphysis pubis*. The ligaments of the pelvis are shown in Fig. 10.

Bones of the Lower Extremities

The Femur.—The thigh-bone or femur (Fig. 11) extends from the hip-joint to the knee; the upper end presents a rounded ball or *head* which fits into the cup (*acetabulum*) on the outer side of the pelvis to form the hip-joint; the head is supported upon a *neck* placed at an angle to the shaft. Where the neck and shaft join, a stout rugged projection of bone, readily felt on the outer side of the hip, is known as the *trochanter major*. Its large size distinguishes it from a smaller projection at the back and inner side of the femur known as the *trochanter minor*. The *shaft* of the femur will be seen to be narrowest in the centre and to enlarge

from thence upwards and downwards. Although the shaft of the femur is smallest in the centre, this is the strongest portion of the bone, owing to the compact tissue at this point being thickest. The lower end of the thigh-bone, where it enters into the formation of the knee-joint, consists of two large knuckles or *condyles*, with a notch between.

The Patella.– The knee-cap or patella is a thick

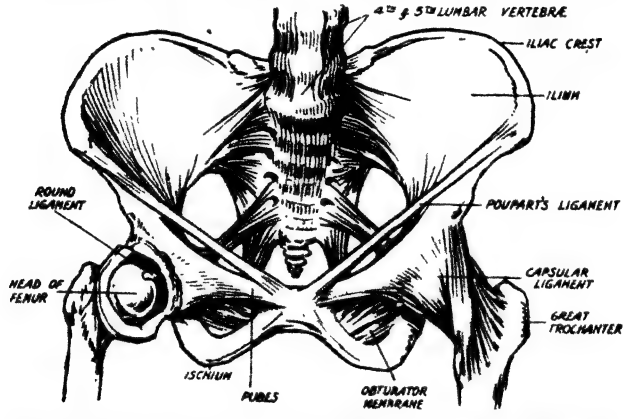


Fig. 10.—Ligaments of the pelvis. Poupart's ligament corresponds to the fold of the groin.

triangular lump of bone situated at the front part of the knee-joint (Fig. 18), where it rests on the lower end of the femur, lying in a groove between the knuckles or condyles; the apex of the triangle is downwards.

The Tibia.—The shin-bone or tibia is the inner of the two bones of the leg, the outer being the fibula. The tibia is much the larger and reaches from the knee to the ankle; the upper end, termed the *head*, supports the lower end of the femur; the *shaft* is triangular in outline, and one border, the shin, can be felt immediately below the skin all the way down the leg. The lower end of the tibia forms the upper part of the ankle-joint; and on the inner side it is prolonged as a stout

tongue of bone—the *internal malleolus*—which serves with the fibula on the outer side to embrace the ankle-bone, and thereby form the inner and outer supports for the ankle-joint. (Figs. 3 and 47.)

The Fibula.—The brooch-bone or fibula, the small bone of the leg, begins just below the knee-joint, where it forms a joint with the tibia, and passes down on the outer side of the leg to the outer side of the ankle, where it ends in a stout tongue of bone—the *external malleolus*—which serves to complete the ankle-joint on its outer side. (Figs. 3 and 47.)

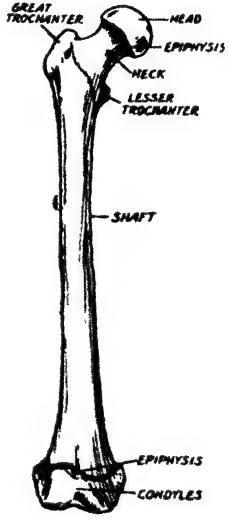


Fig. 11.—Thigh-bone of a youth, showing cartilage at the head and the condyles (epiphyses) before these are united to the shaft.

The Foot.—The bones of the foot are divided into three regions—(1) the foot proper or *tarsus*; (2) five bones supporting the toes, termed the *metatarsus*; (3) and in front of these the bones of the toes, the *phalanges*. (Fig. 12.)

The bones of the *tarsus* are seven in number; the uppermost is the ankle-bone or *astragalus*, which with the tibia and fibula forms the ankle-joint; the heel-bone (the *os calcis*) supports the astragalus, and forms the main bulk of the tarsus. The whole of the bones of the tarsus are jointed together so as to support the weight of the body, break the shock of the tread, and allow of free movement in the foot.

The *metatarsus* consists of five long bones tapering to a point, having the tarsus behind and the toes in front.

The *phalanges*.—The bones of the toes are arranged in three rows, and from their resemblance to soldiers standing in a phalanx they are styled phalanges. The bones in the row next the metatarsus are termed the

first phalanges, those at the end of the toes form the third or terminal phalanges, and the row between consists of the middle or second phalanges. In the big toe there are only two phalanges.

Bones of the Upper Extremities

The Shoulder-Bones.—Just as the lower limbs are supported by the pelvis or pelvic girdle, so are the upper limbs supported by the shoulder girdle, composed of the scapula and clavicle, although compared with the pelvis the shoulder girdle is less complete.

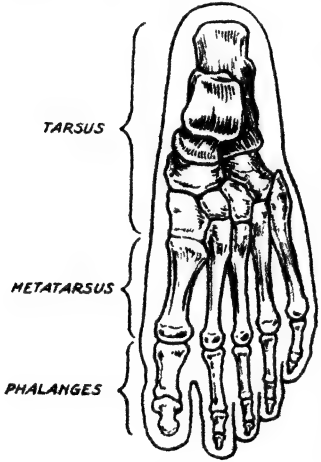


Fig. 12.—Bones of the foot.

The Scapula. — The blade-bone or scapula is a large flat triangular bone lying on the ribs at the upper part of the back of the chest. A ridge of bone constituting the *spine of the scapula* can be felt below the skin at the back of the shoulder; this ridge is continued outwards over the shoulder-joint, where it forms the "tip of the shoulder," the *acromion process* (Fig. 17).

At the outer angle of the blade-bone towards the shoulder-joint, a shallow joint (articular) surface (*glenoid fossa*), shaped like a pear with the wide end below, serves to support the upper end of the arm-bone (humerus) and form the shoulder-joint (Fig. 17).

The muscles which move the arm are mainly attached to the scapula. Owing to the free movement of this bone upon the ribs the scapula is seldom broken.

The Clavicle.—The collar-bone or clavicle, in thickness about that of the ring finger, reaches from the top of the breast-bone (sternum), to which it is jointed,

along the root of the neck in front to the tip of the shoulder (acromion process of the scapula), with the inner border of which it forms a joint. The bone possesses a double curve shaped like the italic letter *f*, and being thereby rendered more elastic, is better able to sustain without breaking the great strain to which it is subjected when one falls on the hand, elbow, or shoulder. The inner curve has its convexity forwards, and the outer curve the convexity backwards. (Fig. 3.)

The Humerus.—The arm-bone or humerus extends from the shoulder-joint to the elbow. Its upper end presents a rounded *head*, which, with the shallow surface (*glenoid fossa*) on the scapula, constitutes the shoulder-joint. The *shaft* is for the most part triangular in shape, but is rather flattened below where it presents articular surfaces on which the bones of the forearm glide to form the elbow-joint. (Figs. 3, 17, 19, 20.)

The Forearm.—The two bones entering into the formation of the forearm are the ulna and the radius.

The **ulna** occupies the inner side of the forearm; its upper end, which is the thickest part of the bone, presents a socket into which the lower end of the arm-bone fits; the tip of the elbow behind is formed by a stout process—the *olecranon*, on which the bent elbow rests when it is placed on, say, the table; the socket for the humerus is formed by the olecranon process behind and the *coronoid* process in front. The *shaft* of the bone is triangular in shape, and gradually narrows towards the wrist, where it ends in a knob (*head*) on the inner side of the wrist-joint. (Figs. 13, 14, 19.)

The Radius.—The outer bone of the forearm extends from the elbow-joint to the wrist; its upper end presents a rounded *head* which enters into the formation of the elbow-joint; the *shaft* is triangular in shape; the *lower* end, the stoutest part of the bone, presents articular surfaces for the bones of the hand. Between the radius and the ulna are two joints, one above and one below; between these two bones the movements of pronation and supination take place. These movements at the wrist require explanation. (Figs. 13, 14, 19.)

Pronation and Supination.—The radius is so named from the fact that it can radiate or rotate upon the ulna;

these movements are termed *pronation* and *supination*. The movements will be understood by following the movements of the hand, for as the radius supports the hand this bone and the hand move together. When the elbow is bent at a right angle and the hand is turned with its palm downwards the hand is said to be in the position of *pronation;* when the hand is turned so that the palm is upwards the hand is in the position of *supination*. In both these positions the shafts of the radius and the ulna are in close contact (Fig. 13, A, B); but when the forearm is maintained in a position midway between pronation and supination, that is, with the thumb upwards and the palm towards the body, the bones are widely apart (Fig. 13, C); this is an important fact to remember when dealing with fractures of the forearm.

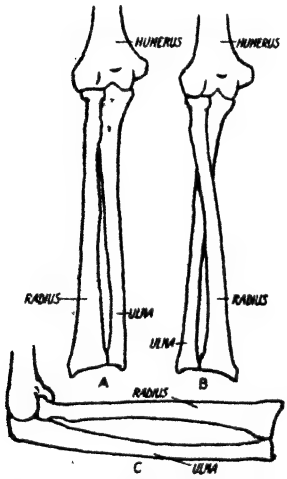


Fig. 13.—Movements of the radius and ulna.

The **hand** (Fig. 14) consists of three portions, the carpus, the metacarpus, and the phalanges.

The *carpus* consists of eight small bones arranged in two rows; the upper row forms with the radius the wrist-joint; the lower row supports the metacarpus.

The *metacarpus* consists of five bones reaching from the carpus to the knuckles; the enlarged lower ends of the metacarpal bones form the knuckles.

The *phalanges* consist of three rows of bones named the first, second (middle) and third (terminal), as in the case of the foot (p. 13). In the thumb there are only two phalanges.

The Skull

The skull (Figs. 15 and 16) is composed of two parts, the *cranium* and the *face*.

The **cranium,** or brain case, consists of eight bones. Of these the bone in front is termed the *frontal* (1), and forms the forehead and the roof of the eye sockets. The bones on either side are—above, the *parietal* bones (2), below, the *temporal* bones (2), in which the ears are contained. Behind is the *occipital*

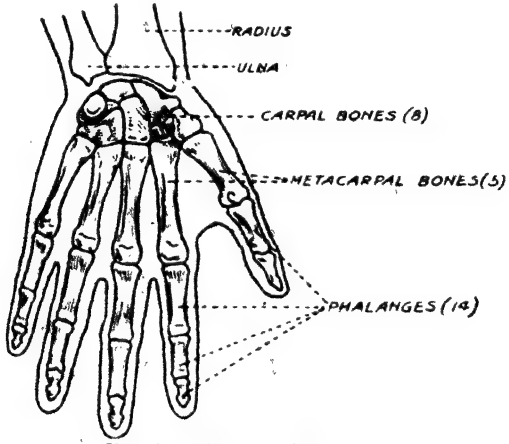


Fig. 14.—Bones of the hand.

bone (1), which forms the back part of the cranium, and also extends below to form part of the back of the base of the skull. In this bone is the large hole (*foramen magnum*) through which the spinal cord passes from the brain to the spinal canal; on the under aspect of the occipital bone, on either side of the foramen magnum, are two bean-shaped nodules of bone which form a joint with the atlas, the first cervical vertebra. The remaining bones are termed the *sphenoid* and *ethmoid;* they form part of the base of the cranium and enter into the formation of the

roof of the nose and the inner sides of the eye sockets. The cranium contains the brain, and presents a roof or vault, a base or floor, the sides or temples, a front aspect or forehead, and a back or occipital region.

There are large apertures or openings (foramina) in the base of the skull through which numerous blood-vessels and nerves enter and leave the cranium.

The **face** consists of bones which enter into the

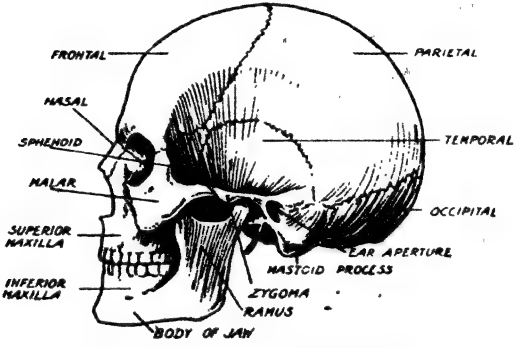


Fig. 15.—The skull (side view).

formation of the nose, the eye-sockets or orbits, and the upper and lower jaws.

The **bones of the face** are—the *nasal* (2), forming the bridge of the nose; the *upper jaw* (*superior maxilla*) (2) forms the main part of the face, and enters into the formation of the orbits, nose, and the mouth where it supports the upper jaw-teeth. The *lachrymal bones* (2) are slender slips of bone on the inner side of the orbits; they give passage to the nasal (tear) duct. The *malar* or cheek-bones (2) form prominent elevations at the outer part of the orbits; they each send a projection backwards to meet a process (zygoma) from the temporal bone, to form the zygomatic arch.

The *lower jaw* (*inferior maxilla*) (1) is a solid piece of bone forming an arc which supports the lower-jaw teeth; behind, it projects upwards vertically to end in an

articular surface, which, with a depression in the base of the skull (temporal bone), forms the joint of the lower jaw just in front of the ear. Where the horizontal (body) portion of the bone joins the vertical (ramus), the angle of the lower jaw is formed, which can be both readily seen and felt beneath the skin about 2 in. below the ear.

The **eye sockets** or **orbits** are conical-shaped cavities with the point of the cone backwards, and the base at the face. Bones of both the cranium and face enter into the formation of the orbits. At the inner side of each orbit close to the nose is seen the channel (*nasal duct*) which conveys the tears from the eye to the cavity of the nose.

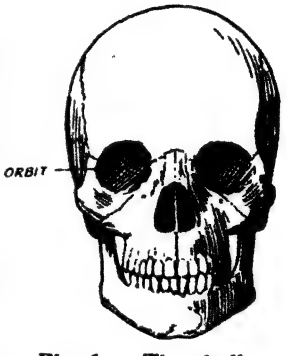


Fig. 16. The skull (front view).

The **nose** presents two passages or nostrils separated by a partition partly bone and partly gristle. The floor of the nose is formed by the bones constituting the roof of the mouth. The roof of the nose reaches to the base of the skull. In front are the nasal apertures, and behind, the nostrils open into the pharynx.

The **mouth** presents the *palate* (hard and soft) above, the *jaws and teeth* on either side, and the *tongue* on the floor. Behind, the mouth opens into the pharynx.

The Thorax

Bony Boundaries.—The chest or thorax is a large dome-shaped cavity bounded by the breast-bone in front, the backbone behind, and the ribs on either side; the portion of the backbone entering into the formation of the thorax consists of the twelve dorsal vertebræ.

The **sternum** or breast-bone is a dagger-shaped bone with its upper end (or handle of dagger) at the root of the neck in front, whilst the point of the dagger,

consisting of cartilage, reaches as far as the pit of the stomach at the upper part of the abdomen. Upon either side of the upper end of the sternum the head of the clavicle rests, and to either side of the shaft of the sternum the upper seven (true) pairs of ribs are attached by their cartilages (gristle).

The Ribs.—There are twelve pairs of ribs, named from above, 1st, 2nd, 3rd, and so on to the 12th (the lowest). The upper seven pairs reach from the backbone to the sides of the sternum, and are termed the *true* ribs; the lower five pairs fall short of the middle line of the body and are termed the *false* ribs.

Each rib is jointed behind by its *head* to the vertebral column in the dorsal region; the *shaft* winds round the side of the chest to the front, where it ends in cartilage (rib cartilage) and forms a true or false rib, according to its position in the chest. The head is supported by the *neck* of the rib, and where the neck and shaft join there is a knob (tubercle) on the posterior (back) aspect of the rib, on which a smooth articular (joint) surface exists to articulate (form a joint) with a corresponding surface on the front of the tip of the transverse process of a dorsal vertebra.

CHAPTER III

JOINTS AND MUSCLES

I. Joints

A JOINT, technically termed an *articulation*, is formed at the place where bones meet. Joints are either movable or immovable. Movable joints we find examples of in the limbs at the hip, knee, elbow, and fingers. Immovable joints are met with between the bones of the skull, pelvis, etc.

Movable Joints.—The surfaces of the bones where they meet to form movable joints are covered by gristle

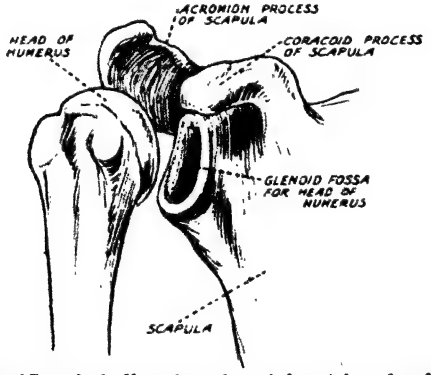


Fig. 17.—A ball-and-socket joint (the shoulder).

or cartilage, technically termed *joint or articular cartilage*. Cartilage serves to smooth the bony surfaces, to allow of free and noiseless movements, and to break the shock consequent upon the pressure due to the weight of the body. Within, the joint is lubricated by a clear fluid of a thin syrupy consistence called the *synovia* or synovial fluid. The fluid is secreted and kept in place

by a delicate membrane with a glistening inner surface, passing from bone to bone, termed the *synovial membrane*. This membrane is strengthened by fibrous tissue spread out in the form of a *capsule* (Fig. 10), and the bones are firmly held in place by thick fibrous bands termed *ligaments*, passing at intervals between them. The ligaments, while they serve to strap the bones together, yet allow of the movements peculiar to each joint. Of the movable joints some are arranged (1) as a ball-and-socket mechanism (Fig. 17), whereby "universal" movement is possible, as in the hip and shoulder. (2) Others, such as the knee (Fig. 18), ankle, elbow (Figs. 19, 20), and lower jaw, are capable only of *hinge*-like movements. (3) In the hands and feet, between the bones of the tarsus and carpus, *gliding* motions are alone possible.

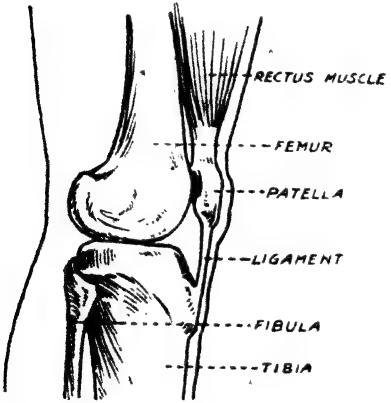


Fig. 18.—A hinge-action joint (the knee).

Immovable Joints.—These joints are more in the form of seams, and appear like cracks between the bones, as in the skull, where the edges of the bones are dovetailed into each other without any intervening cartilage, so that the amount of actual movement is infinitesimal, or altogether absent. In the pelvis and elsewhere the bones are separated where they meet by a piece of cartilage, but there is no synovial fluid nor appreciable movement; the cartilage in these cases serves as a mere buffer to break shock due to violence.

Intervertebral Discs.—In the spine the vertebræ of

the neck, back and loins are separated by large masses of cartilage strengthened by fibres (*fibro-cartilage*) constituting the discs between the vertebræ (*intervertebral*

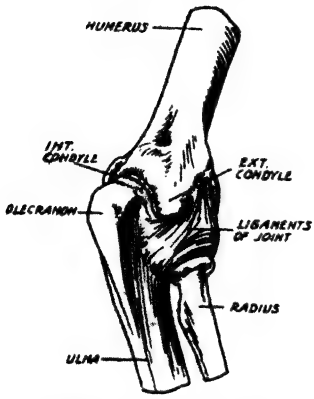


Fig. 19.—The elbow-joint.

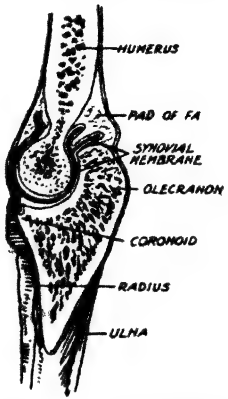


Fig. 20.—The elbow-joint in section.

discs), as mentioned in Chapter II. Along the front and back of the bodies of the vertebræ strong ligaments bind the bones together into a flexible column.

II. Muscles

Muscles we are familiar with in the form of the flesh of animals. A piece of beef consists of reddish material —flesh, or muscle, and a yellow substance—fat. In human anatomy there is, technically, no such substance as flesh. When an animal is poorly fed or has been engaged in pulling vehicles or a plough, etc., as a horse, and in some instances oxen, the muscles are hard, and if an attempt is made to eat them the meat is tough. If, instead, the young ox is kept indoors and well fed, or on good pasture, fat becomes deposited among the muscle fibres, and the result is flesh which is easily chewed and therefore readily digested. It is to the tender meat thus produced that the term flesh

is applied. When a piece of meat is boiled for a time it is seen to break up into long **fibres,** for the materials which bind the fibres together have been dissolved and the mass seems stringy. These bundles may be still further broken up into finer fibres, and if examined by a microscope the fibres are seen to be very small, and present characteristic dark stripes, rendering the muscle striped or *striated.* The stripes or dark crossings in the fibres mark the separation between the ultimate elements (cells) of which the meat (muscle) is composed. When a muscle contracts the fibres swell up in the centre and its ends are approximated; this movement explains the action of muscles, and may be readily understood by placing the hand over the biceps muscle in the front of the arm, clenching the fist and forcibly bending the elbow, when the muscle can be felt to swell up into a hard lump; when muscles relax, the hardness subsides and the lump disappears.

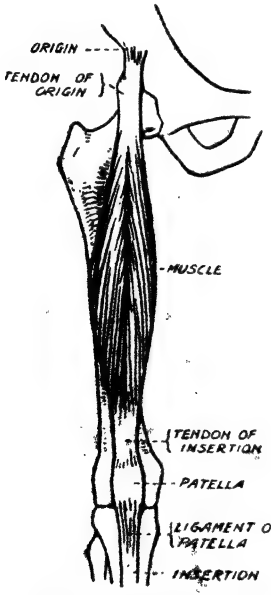


Fig. 21.—Muscle and tendons.

By the muscles all movements of the body are executed. Muscles are of two varieties—(*a*) voluntary and (*b*) involuntary.

(*a*) **Voluntary Muscles.** — The muscles of the limbs, the neck, the face and eyes, and the surface of the trunk are capable of movement at the will of the individual, and are therefore termed voluntary. A muscle, to occasion movement, must cross a joint, and some muscles cross several joints. The more fixed point to which

a muscle is attached, and from which it acts, is termed the *origin* of the muscle (Fig. 21); the other end of the muscle, which may be at a considerable distance and at which the movement is carried out, is termed the *insertion* of the muscle. A muscle where it arises from the bone may consist of muscle or of tendon (popularly termed a "leader"). From the origin the muscle increases in bulk, and after forming the *belly* of the muscle it again narrows as it proceeds on its course. Where it crosses a joint it usually assumes a non-muscular character, tapering off into a tendon, and as a tendon it is inserted into the bone on which it is to act. The tendons, more especially in the case of the hand and foot, are enclosed in sheaths lubricated by clear fluid resembling in appearance the synovia of joints.

The simplest forms of movement are observable in the fingers, toes, knee, ankle, elbow, and other hinge-joints where the movements are primarily confined to straightening and bending, or, as they are technically called, *extension* and *flexion*; thus when the hand is clenched the fingers are said to be flexed, when the hand is opened the fingers are extended. Other movements, as in the case of the hip and shoulder ball-and-socket joints, are more numerous. In the case of the hip-joint, flexion is observed when the thigh is bent so that it touches the wall of the abdomen, and extension consists of straightening the limb so that it is in a line with the body. Other movements at the hip-joint are *adduction*, when the thigh is brought inwards so as to touch its fellow, and *abduction*, which means moving the thigh outwards or away from its fellow. In the case of the shoulder-joint, when these movements are rapidly carried out, a circumferential or rotatory movement is given; in other words, the arm can be swung round in a circle (*circumduction*). (For Extension and Flexion, Abduction and Adduction, *see* Figs. 1 and 2.)

(*b*) **Involuntary Muscles.**—Along the whole length of the alimentary canal, from the throat to the lower end of the intestines, the walls of the digestive tract possess a muscular structure, which, from the fact that the elements of which it is composed are independent of

the will, is termed the *involuntary muscular system*. The muscles of this system differ also in structure from that of the voluntary, inasmuch as they are not formed up in bundles of muscular fibres, but consist of muscle cells spread out into areas not attached to bones, and forming a complete coating to the tubes they enclose. The muscle is not striped or striated as in the case of voluntary muscle, but appears quite smooth. The movements of involuntary muscles resemble those observed in a worm (*vermis*), and are hence termed *vermicular movements*, and it is by this action that the food is passed along the alimentary canal during digestion.

Heart Muscle.—The heart muscle belongs to neither of these divisions of the muscular system, but consist of special fibres which are but very indirectly under the control of the will and emotions.

Tendons.—At its origin and insertion a muscle is frequently fixed to the bone by tendons in place of muscle fibres. Some tendons are of great length, especially in the case of the hands and feet. The muscles which move the fingers and toes lie in the forearms and legs respectively, and, from these muscles long tendons pass over the wrists and ankles to the hands and feet, and onwards to the fingers and toes. Tendons appear as stout cords of a yellowish tinge and glistening appearance. The *tendo Achillis*, at the back of the heel and ankle, whereby the muscles of the calf of the leg act upon the heel and raise it in walking, running, and jumping, is of enormous thickness and strength. The *ligament of the patella*, extending from the lower end of the knee-cap to the shin-bone, is also of great prominence (Fig. 18.)

Tendons are termed *tendons of origin* and *tendons of insertion*, according as they are met with at the place where the muscle arises or where it is inserted. (Fig. 21.)

CHAPTER IV

FRACTURES

Causes of Fracture.—A bone may be broken (1 by direct violence, (2) by indirect violence, (3) by muscular contraction, or (4) by "spontaneous" fracture, as when a bone breaks as the result of disease.

1. By *direct* fracture is meant fracture of a bone, say by a blow, a fall, the wheel of a vehicle, or a bullet, in which the force of the impact is applied directly over the spot at which the bone is broken.

2. An *indirect* fracture is due to an impact applied at some distance from the spot at which the bone is broken. Thus, a fall on the hand may cause a fracture of the radius or of the collar-bone; alighting from a height on the feet, the bones of the feet may escape fracture, but the bones of the leg, the thigh-bone, or the pelvis, or even the skull, may be broken.

3. *Muscular Contraction.*—A fracture may be caused by a violent contraction of the muscles when the bone on which the muscles act is caught at a disadvantage. This is especially met with in the case of the knee-cap (patella).

Different Kinds of Fracture

1. **Simple Fracture.**—When a bone is snapped directly across its length it is said to be a *transverse* fracture (Fig. 22). When a bone is broken in a slanting or oblique fashion the fracture is termed an *oblique* fracture (Fig. 22). In an oblique fracture the bony fragments present jagged edges, and the ends of the bone overlap. Overlapping or over-riding of the broken ends of a bone is due to the lower fragment being pulled upwards over the upper fragment by the contraction of the muscles. Some hæmorrhage occurs also at and around the seat of fracture, as evidenced by the immediate swelling and

the subsequent discoloration around the spot where the bone is broken.

2. **Comminuted Fracture.**—When a bone is crushed by a heavy weight, by the wheel of a vehicle, or struck by a bullet, it may be broken into a number of pieces. The bone is said to be smashed or comminuted (Fig. 22), and a number of small fragments intervene between the main ends of the broken bone. In this case the damage is greater than in a simple fracture; the bruising is more extensive; there is the additional danger of some of the broken fragments, owing to their separation from the surrounding tissues, coming away subsequently as pieces of dead bone; or inflammation may develop and an abscess may form locally, or blood poisoning may ensue.

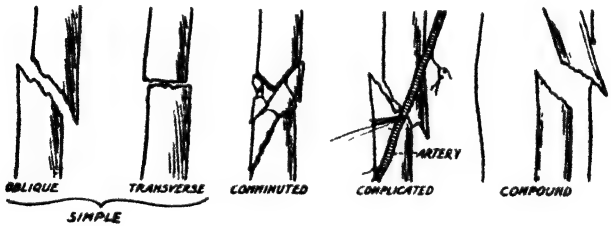


Fig. 22.—Various types of fractures.

3. **Complicated Fracture** (Fig. 22).—When a bone is broken its jagged edges may tear an artery, a vein, or a nerve, or may penetrate some internal organ. Such an accident is very likely to happen owing to careless movement of the broken part. When a large *artery* is torn the hæmorrhage around the seat of injury will be great, causing extensive swelling and subsequent discoloration; if the main artery is torn all pulsation in the arteries below the seat of injury will cease. When a large *vein* is wounded there will also be extensive effusion of blood around the seat of the injury, but the pulsation in the arteries throughout the limb will remain intact. When a *nerve* is torn through, the muscles supplied by the nerve will be

paralysed and the skin will lose its sensation. Should the fractured end of the bone tear one of the *internal organs*, such as the brain, lung, liver, spleen, kidney, etc., there may be hæmorrhage, arrest of function of the organ, escape of secretions, such as bile from the liver, urine from the kidney or bladder, the contents of the wounded stomach or intestines, or other complications.

4. **Compound Fracture.**—When a bone is broken and the skin over the seat of the fracture is torn so as to allow the air to enter between the fractured ends, the injury is termed a compound fracture (Fig. 22). In some cases the fractured ends may protrude through the wound in the skin; or, on the other hand, the wound in the skin may lead down to between the broken fragments, although their displacement may be slight. Should at the same time a large blood-vessel be torn and blood escape through the wound in the skin, the fracture is termed a *compound complicated fracture*.

Fig. 23.—Green-stick fracture.

5. **Green-Stick Fracture.**—In children the bone may crack without being broken completely across, in which case the fracture is said to be a green-stick fracture (Fig. 23). This fracture occurs most frequently in the thigh-bone, the clavicle, the humerus, and the forearm. Injudiciously lifting young children by their hands may cause green-stick fracture of a bone in the upper limb or sometimes in two bones simultaneously. Again, when a child is being carried in the arms, its thighs rest upon the nurse's forearm and the legs hang down between the forearm and the nurse's body; should the child swerve or throw itself backwards whilst being carried in this position, the nurse, to prevent the child falling, involuntarily grasps its limbs to her body, and the thigh-bone (or bones) is cracked across the nurse's forearm. A green-stick fracture is difficult to make out, as the deformity is slight, and the limb is only

partially incapacitated. The pain, however, in certain movements causes the child to cry or complain bitterly, and some swelling is always to be found over the seat of the fracture.

6. **Impacted Fracture.**—When one end of a broken bone is driven into the other and the two are so firmly fixed that separation is possible only by strenuous effort by the doctor, the fracture is said to be impacted. A fracture of this nature is caused by the force that fractured the bone still continuing, and before the two ends can escape from each other one is driven into the other. The lower end of the radius (Colles's fracture) is the most frequent situation where this accident is met with. Crepitus is absent, the deformity is slight, no gap can be felt in the bone, and though movement of the limb is impaired, it is not wholly impossible. (Figs. 41 and 42, p. 54.)

7. **Depressed Fracture.**—When a piece of the skull is broken off and driven inwards, the injury is termed a depressed fracture, and causes compression of the brain (*see* p. 132).

8. **Muscular Violence** (*see* p. 41).

Signs and Symptoms of Fracture

By a *sign* is meant the several points which the bystander can make out or observe. By a *symptom* is meant the evidence the patient can give from the sensations he experiences. Pain is a symptom; swelling, deformity, discoloration, etc., are signs.

To understand the signs and symptoms present when a bone is broken, a **fracture of the thigh** will form the best object-lesson, owing to there being but a single bone in this part of the limb. Supposing the femur of the right thigh is broken in the centre of its shaft, the following points will be noted:—

1. **Unnatural Position of the Limb.**—The right foot will be found lying on its outer side, and the whole limb below the seat of the fracture, turned outwards or everted; in some rare cases the foot may be turned inwards.

2. **Shortening of the Limb.**—Owing to the overriding of the fractured ends due to the contraction

of the muscles, the heel of the injured side—the right side in this instance—will be seen to be drawn up from 1 to 3 in. in extent, that is to say, the limb is shortened.

3. **Deformity.**—The thigh will present an abnormal shape at the seat of the fracture, and the limb below will occupy a faulty position.

4. **Swelling.**—Owing to the over-riding of the fragments, the bulge caused by the contraction of the muscles and the effusion of blood, there will be considerable swelling at and around the seat of the injury.

5. **Discoloration.**—Should the fracture have been due to direct violence, discoloration will be seen almost immediately; in fractures caused by indirect violence, discoloration may appear after a few hours, or not until a few days have elapsed.

6. **Pain.**—Unless the patient is rendered unconscious by the accident, pain will be complained of at the seat of the injury.

7. **The Fracture may be felt.**—The break in the bone may be felt by passing the finger over the seat of the injury. This sign is more apparent in the shin-bone, the collar-bone, the lower jaw, the metacarpal and metatarsal bones of the hand and foot, or any other bone which is immediately below the skin, than in the thigh-bone or the pelvis, etc., where the muscular covering is thick.

8. **Crepitus.**—The least movement of the fragments of a broken bone when the hand is placed over the seat of the fracture may occasion the sensation of crepitus or crepitation, that is, a bony grating due to the rough ends of the bone rubbing against one another. This is very evident in the case of a fractured thigh when the foot of the injured side is pulled down so that the limb of the injured side becomes the same length as the sound limb, as by so doing the bony fragments are no longer over-riding, but are actually made to move across each other, their jagged ends grating the one upon the other.

9. **Uselessness of the Limb.**—Inability to use or even to move the broken limb is especially marked when one bone only is present, as in the case of the

femur, the humerus, and the clavicle; in parts where two bones are present, as in the leg and forearm, the inability may not be so apparent.

10. The **history of the accident,** as given by the patient or seen by bystanders, is useful.

11. The **feeling of "something having given way"** or "snapped," and even the noise caused by the fracture at the time the accident occurred, favour the conclusion that a bone is broken.

12. **Clothing.**—If the passage of a wheel, a falling body (such as a plank), or a bullet, causes the fracture, the clothing over the seat of the fracture may be torn or soiled.

Absence of Certain Signs and Symptoms.—It is seldom that all of these signs and symptoms are present in any given fracture. Thus, in the case of a broken thigh due to indirect violence, as from alighting on the feet, there will be *no mark on the clothing*. If in the forearm or leg, where two bones are present, only one is broken, the length of the limb will be maintained by the sound bone, so there will be *no shortening*. If the patient is unconscious there will be *no pain*. If the fractured ends, instead of over-riding, are driven the one into the other (impacted), there will be *no crepitus*. However, a sufficient number of the signs and symptoms mentioned above are present in almost every case to render the evidence of the bone being fractured fairly certain.

General Treatment of Fractures

1. **Render the Joint immediately above and below the Seat of the Fracture immovable.**—The main principle to be followed in all cases of fracture in the limbs is to place the fracture at rest by immobilising the joint immediately above and below the seat of the fracture. This is accomplished by applying a splint long enough to extend from beyond the joint above to beyond the joint below the fractured bone. Thus, in the case of a broken leg, the knee-joint and the ankle-joint must be fixed by a splint long enough to reach from above the knee to beyond the ankle; in the case of a broken thigh-bone, from above the hip to below the

knee; in the case of a broken forearm, from above the elbow to below the wrist.

2. **Attend to the Broken Bone before moving the Patient from the Spot where the Accident happened.**—No matter how crowded the thoroughfare where the accident has occurred, when the thigh-bone, the bones of the leg, the pelvis or the spine is broken, the patient must be attended to at the spot where he lies, and the traffic has to be held up until a splint has been applied to the broken limb, when the patient may be moved to shelter. On the field of battle a soldier with a broken thigh or leg, however fierce the fighting, must not be moved until a splint is fixed. In the street, however near the edge of the pavement he may be, the patient must not be removed from the roadway on to the footway until a splint has been applied. If he is indoors, the broken limb must be fixed in splints before even an attempt is made to place him upon a couch or bed. Perhaps the only situations (except possibly in uncivilised warfare) in which moving a patient without first fixing the limb is a justifiable act are when he is threatened by flames in a burning house, or lying in a railway track between the rails and a train is approaching.

3. **Local Treatment Varies with the Kind of Fracture.**—(*a*) In *simple fracture*, after attending to the break, a handkerchief, lint, linen, etc., dipped in cold water, or an ice-bag, may be laid over the seat of the fracture. (*b*) In *comminuted fracture*, after adjusting splints, cold applications may also be used. (*c*) In *complicated fracture* in which a large blood-vessel is torn, causing great swelling around the fracture, the application of splints and cold is the only immediate treatment possible. When, however, an important organ is wounded, such as the brain, stomach, liver, or lung, the special treatment indicated for these injuries (p. 55) must be carried out. (*d*) In *compound fracture* adjust the broken limb as in simple fracture, but the wound must be cleansed, if necessary, with a clean piece of linen or lint dipped in boiled water, and covered with a dressing of clean linen or lint soaked in boiled water, or instead in some antiseptic such as carbolic oil or lotion 1 in 40 (1 part pure

carbolic acid to 39 parts oil or water). Cover the dressing with oiled silk or grease-proof paper if available; if not, envelope the whole in a thick layer of cotton-wool, and apply a bandage. (*e*) In a case of *compound complicated fracture* in which the wound in the skin exposes the broken bone, and a large artery is wounded, the hæmorrhage must be arrested before anything else is done. The subsequent treatment is the same as for compound fracture. (*f*) In *green-stick fracture* the bone requires to be kept at rest by a splint, sling, or appropriate bandage. (*g*) An *impacted fracture* requires no correction in position, except perhaps subsequently by the doctor, and is to be treated by the application of a splint. (*h*) A *depressed fracture* of the skull is to be covered by a dressing and left for the doctor to deal with; the condition it induces, namely, compression of the brain, needs immediate attention. (*i*) *Fractures by muscular violence* are dealt with on the general principles laid down for fractures caused by direct and indirect violence.

4. Shock. — In all cases of fracture the shock occasioned by the accident requires attention. The patient must be prevented from becoming cold by being covered up at once, even whilst the fracture is being attended to (*see* p. 141).

The **apparatus** used in treating fractures are splints, bandages and pads. *Splints* may be improvised from any material sufficiently stiff to prevent "giving" when strain, as in bending a limb, is put upon it. The material may be of metal, wood, or folded newspapers or cardboard if stout enough. *Bandages* may be of calico or linen, etc., stiffened with plaster of Paris, or starch, etc.; roller bandages may be used in the later stages of the treatment of fractures. *Pads* of cotton-wool, secured in gauze or lint, made of a spherical or flat shape in different sizes, and placed between the splints and the limb, are useful as a means of supporting a part, taking off the pressure, and thereby preventing injury to the skin. A circular pad with a hole cut in its centre is used to accommodate a projecting piece of bone, as at the sides of the ankle-joint. Padding splints, to prevent pressure of the splint on the skin and to afford comfort, may be carried out in various ways, as follows:—

(*a*) An improvised padding for a splint consisting of a towel (or towels) folded to the breadth and length of the splint may be simply laid on one side of the splint and interposed between the apparatus and the skin. A strip of clothing of any kind may be similarly used, and in emergency a bundle of straw or hay suitably arranged will form a sufficient temporary padding.

(*b*) Another ready method of padding a splint consists of cotton-wool, tow, etc., held in place by a roller bandage. The padding material—wool, oakum, etc.—to the depth of 3 to 4 in., is laid along one side of the splint from end to end and wide enough to overlap the edges. A roller bandage is now wrapped round the splint and padding in such a way that the ends and length are covered. To cover the ends the bandage must be carried backwards and forwards over one end to begin with, the various folds being retained by circular turns round the body of the splint, as in bandaging the finger-tip; one end being covered, the bandage is carried round the splint and padding in a simple spiral fashion and the other end finally covered.

(*c*) Regulation padding of splints is carried out by covering the splint with padding material 3 or 4 in. deep smoothly and evenly, so that both the ends and sides are well overlapped. A piece of calico is now cut of sufficient size to overlap the padding material to the extent of a couple of inches all round. The edges of the linen are then brought round the splint and stitched by needle and thread along the back of the splint.

The material used for padding may be plain cotton-wool, surgical cotton-wool, tow, oakum or charpie, wood-wool, flock, or sheep's wool; or hay, straw, dry ferns or rushes in emergency, or even pieces of paper, wood shavings or clean rags.

Bandages may be roller or triangular, or any appliance long enough and strong enough may be improvised. As examples of improvised bandages may be mentioned braces, belts, neckties, rope (straw or hemp), twine, handkerchiefs (single or knotted together), strips of linen, cotton or cloth of any kind.

The ends of a triangular bandage are secured by a reef knot (not a granny, as it slips), and are tucked out of sight beneath the folds of the bandage. The end of a roller bandage is pinned, or split and tied.

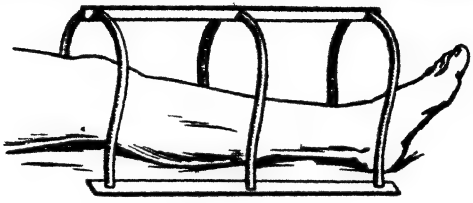


Fig. 24.—Prepared cradle.

Cradles.—As a means of preventing pressure of bed-clothes or any covering on a limb or the trunk, various

Fig. 25.—Improvised cradle.

devices are to hand; these are termed cradles, and may be either prepared or improvised. The prepared

Fig. 26.—Improvised cradle.

cradle (Fig. 24) consists of stout wire loops fixed in pieces of wood. Improvised cradles may be made from a three-legged stool (Fig. 25), a band-box (Fig. 26) or similiar devices.

How and where to pass Bandages.—When applying improvised bandages to secure splints, especially for the trunk and the lower extremities, the bandages should be passed beneath the natural hollows between the trunk or limb and the floor (or ground). There are three such in the lower limbs—one immediately above the heel, one behind the knee, another below where the hip bulges at the upper part of the back of the thigh. After being passed along these natural hollows, the bandages are worked downwards or upwards to their required positions. The hollow at the back of the waist is also utilised for this purpose, the bandages being carried upwards or downwards towards the chest or behind the hips as required. Never raise a limb to pass a bandage; never attempt to pass a bandage where the trunk or limb rests on the floor (or ground), such as behind the calf, the hips or the back. To facilitate the passing of bandages beneath the body and limbs a good plan is to double the folded triangular bandage on the end of a splint, walking-stick or other rod, and push the stick with the bandage on it beneath the hollow at the back of the heel, knee, hip, waist or neck.

Fractures of the Spine, Pelvis, and Lower Limbs

Fractured Spine.—The spine may be fractured in almost any part of its length. The danger of a fractured spine is not so much the injury to the bones, but the compression, wounding or severing the spinal cord; and the degree of danger when the cord is injured depends upon the seat of the injury. The lower down the spine the fracture occurs, the less the immediate danger to life. When the spine is broken above the 5th cervical vertebra, and the spinal cord is severed, death is usually instantaneous. When the spinal cord is torn through as the result of a fracture at or immediately below the 5th cervical vertebra, all the muscles of the body below the seat of the fracture will be paralysed (motor paralysis); the skin will lose all sensation (sensory paralysis); the muscles will lose the power of motion equally on both sides of the body;

the upper extremity may be paralysed when the fracture is at the 5th cervical, so that only the movements of the head will be possible. If the accident occurs in the middle of the back, the muscles of the lower extremities and those of the wall of the abdomen will be paralysed; the bladder may also be involved, and its contents constantly dribble away. The reason that a patient with a fracture of the lower part of the neck vertebræ lives, seeing that all the muscles of the upper and lower limbs and of the chest wall and abdomen are paralysed, is that the nerves (phrenic) which supply the diaphragm (midriff), and by which alone breathing is carried on, come from the 3rd and 4th cervical vertebræ and pass one on either side down the neck and chest to the diaphragm.

Treatment.—If the back is presumed to be broken, or is actually known to be so, do not move the patient, but instead, and without rolling him over, or raising him in any way, lay a blanket, horse cloth, or sacking on the ground in a line with his head; two helpers kneeling, one on either side, then drag the edge of the blanket firmly down beneath the patient's shoulders and pull it onwards beneath the hips and lower limbs; this will take time and some care, as the patient must not be raised nor the blanket rolled, but by puckering it and then dragging the blanket can be passed. It is a good plan to commence by passing the blanket from the feet to the head instead of vice versa. With the patient on the blanket, lay two poles some 7 ft. in length on the edge of the blanket, and roll them in the blanket close up to the side of the patient's body. Four bearers, two on either side, standing at the stretcher corners and facing each other, grasp the poles with the blanket wrapped round them, their hands well apart, and, raising the patient, carry him by a side pace slowly under cover, or on to a stretcher or bed. Instead of passing the blanket beneath the patient, the patient's coat, when opened, may be rolled firmly close up to the sides of the body, and, with a bearer on either side, the coat may be grasped and the patient lifted; while two other bearers, standing on opposite sides of the thighs, may pass their hands beneath the

hips and legs, and, acting in harmony with the coat bearers, slowly and gently raise the patient and carry him to a stretcher or bed.

Fractured Pelvis.—The pelvis may be fractured by the passage of a wheel over the lower part of the body, by a fall on the bone itself, or indirectly by a fall upon the feet. The fracture may be confined to one side of the pelvis, or both sides may be broken. The dangers in the fracture of this bone are mostly confined to injury of the organs within its walls, the bladder and the bowel being especially susceptible to damage. A fracture of the pelvis will render the patient incapable of standing, or of freely moving the lower limbs when lying down. Moreover, crepitus may be felt when the hands are placed on the haunch-bones on either side, but this sign should never be sought for except by a doctor.

Treatment.—When a fracture of the pelvis has occurred or is suspected, (1) place the patient lying down on the back with the lower limbs either straight or flexed according as the patient finds comfort in the position. (2) The upper part of the body is to be either raised or lowered as the patient desires. (3) A broad-fold bandage is to be passed round the pelvis and tightened only to such an extent as to afford support; the centre of the bandage to be placed in the middle of the back and the knot on the middle of the body in the front. (4) All movement must be prevented. (5) A blanket, horse cloth, or canvas is to be passed beneath the patient with the least disturbance possible, so that he may be carried upon it. During the conveyance of the patient such alterations of the position may be made as he desires for his comfort.

Fractured Femur.—The femur may be broken at its neck or anywhere in its shaft. Fracture of the *neck* of the femur occurs most frequently in old people. A very slight amount of violence, such as tripping on a carpet, or missing a step on the stairs, may cause the fracture. Fracture of the *shaft* of the bone occurs in people of any age, and is caused by great violence, which may be either direct or indirect.

The signs and symptoms of fracture of the femur have been given above (p. 30). In young adults the

lower end of the femur is not infrequently separated from the shaft; the explanation of this fracture is that up to the age of 21 the femur and other long bones of the limbs consist of three pieces, a shaft, and an upper and lower end, separated by a layer of cartilage. A sudden wrench in the neighbourhood of a joint in the limbs of young people may tear through the cartilage (gristle) between the shaft and either end (epiphysis) of the bone. It is difficult except for a doctor to pronounce definitely that such an accident has occurred (Fig. 11).

Treatment.—In fracture of the femur, as in all fractures of the lower limbs, the accident must be attended to at the spot where the patient lies. For fracture of the *middle of the shaft*—

1. If two or more helpers are at hand one grasps the foot of the injured limb (with or without removing the boot) with a hand on either side of the foot. With a gentle but firm pull, while the part is thus grasped, the foot is steadily and gradually brought down to the same length and to the same position as the sound foot; in this position the foot is maintained while the other helper applies a splint and bandages.

2. If but *one* helper is at hand the foot of the injured limb is pulled down in the same manner, and when brought alongside of the sound foot, the two feet are tied together by a broad-fold bandage or a couple of handkerchiefs knotted together; the bandage or handkerchiefs are passed behind the ankles, just above the heels, where a hollow exists rendering it possible to pass the bandage without moving or raising the limbs; the centre of the bandage should be at the back of the limbs, and the ends carried forward, crossed over the insteps, passed round under the soles of the feet, or beneath the waists of the boots, and tied where convenient either above or below the foot. The helper, if single-handed, is now free to apply splints and bandages to the broken limb.

3. A splint for the thigh may be improvised from the long handle of a broom, from a couple of billiard cues, a rolled-up map, or from any piece of

wood, round or flat, long enough to reach from the armpit to just beyond the foot. The broom, if undetached from the handle, is to be applied with the brush end uppermost, close to the armpit; the billiard cues are to be placed the thick end of one against the tapering end of the other. The splint is then laid against the outer side of the trunk and limb of the injured side (Fig. 34).

4. If the limb is being steadied by a helper holding the foot, the *first* bandage is to be applied round the foot and splint; it is passed behind the hollow immediately above the heel of the injured side, and embracing the ankle and splint, the ends are crossed over the instep; one end of the bandage is made to take a firm turn round the splint, after which the ends are carried round the foot and tied where they happen to end. The *second* bandage, a broad-fold bandage, is passed behind the hollow of the back (waist) and slipped upwards until just below the armpits and carried round the chest close below the armpits, pulled firmly, and the knot tied tightly on the outer side of the splint. Always take a turn round the splint with one of the bandage ends before tying off. The *third* bandage is passed behind the waist and slipped down to the level of the hip-joints; it is then carried round the trunk of the body at the level of the hip-joints, and firmly tied on the outer side of the splint. The *fourth* bandage is now passed along the hollow below the hip and slipped downwards to just above the seat of the fracture. In this situation it is well to pass the bandage doubled. Take a triangular narrow-fold bandage, double it, pass the centre of the bandage thus folded from the outer side of the limb beneath the splint and thigh, just below the hollow formed by the bulge of the hip. If the bandage is folded over a stick or flat piece of wood it is more readily passed. When the loop of the bandage is seen upon the inner side of the thigh, pull it forwards and over the front of the thigh as far as the splint on the outer side of the limb. Each end of the bandage is passed through the loop from opposite sides, and tied upon the splint. The *fifth*

bandage is passed and secured in a similar manner; it is well, to prevent movement of the limb, to pass this bandage behind the knee, and to slip it upwards to just below the fracture and there secure it. The *sixth* bandage is made to encircle both knees, and the knot tied on the outside of the splint; the *seventh* bandage is used to tie the legs together. An *eighth* bandage may be applied as a perineal band (Figs. 29, 34.) When a suitable splint is available it may be applied on the inner side of the thigh. The inner splint should reach, on the inner side of the limb, from just below the spot where the thigh

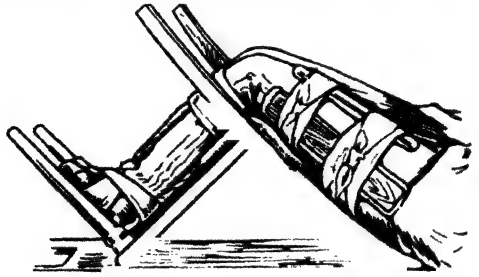


Fig. 27.—Treatment of fracture of upper third of femur.

joins the trunk (fork) to the knee. This splint is secured in position by the bandages above and below the seat of the fracture, and included in the bandage which has been passed round both knees.

When the fracture is at the *upper part of the femur*, just below the hip-joint, the femur should be put up in a flexed position and the part supported as shown in Fig. 27. This position is necessary owing to the upper fragment projecting forwards and threatening to render the fracture compound by penetrating the skin on the front of the thigh.

Rifle Splint.—In a case of fractured thigh, a rifle may be applied along the injured side from the armpit to beyond the foot. To get extension on a splint of the kind is a necessity in order to keep the

broken ends of the fractured thigh from overriding each other. As a means to this end a butt loop over the upper end of the splint is of great advantage. The loop is made as follows: First remove the bolt from the rifle and see that the magazine is empty. Keep the rifle vertical with butt end uppermost; lay a narrow-fold bandage (or scarf) on the end of the butt, one-

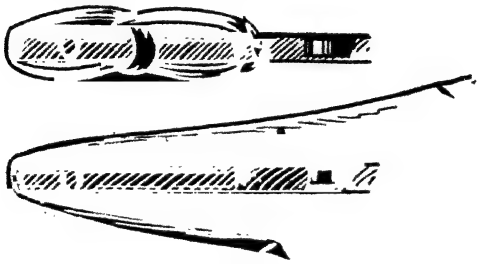


Fig. 28.—Butt loop for rifle splints made as for left side.

third being on one side and two-thirds on the other. The long end should fall on the side of the rifle which is away from the body when the splint is applied. Carry the long end round the butt and over the short end, as in Fig 28, and form a half-hitch by passing

Fig. 29.—Rifle splint, showing butt loop and perineal band passed through it.

the long end between the rifle and the bandage. The ends are then tied, and a loop formed, the knot being on the back of the rifle.

With the rifle and butt loop so prepared, apply the splint to the injured side (Fig. 29); the muzzle of the rifle reaching 2 in. beyond the foot. Fix a bandage round foot and ankle and the barrel of the rifle, taking

a turn of the bandage round the barrel for better security. A bandage (a narrow-fold triangular bandage, or a roller bandage doubled) is passed to the inner side of the thigh right up to the perineum—that is, where the inner side of the thigh joins the body. One end of the bandage is carried over the front of the body, the other round the back of the hip; the ends are passed through the butt loop; extension is made so that the limb of the injured side is of the same length as the sound limb, and the perineal band is securely tied so that the length of the limb is maintained. The other bandages are then applied to the thigh and leg.

Fig. 30.—Fractured patella.

Fractured Patella.—The knee-cap may be broken by direct fracture by falling upon the bone, when it is usually broken into a number of pieces (starred fracture), but more frequently it is broken by muscular violence into two pieces, an upper and a lower. When the fracture is due to *muscular violence*, the accident is apparently of a slight nature. For instance, in going upstairs, one foot slips, the whole force of the muscles of the thigh is called into play to prevent falling, and the strain thus thrown upon the patella, whilst the knee is bent, is such that the bone may break. The patient, feeling the support of one knee gone, tries to recover his balance, and the sudden strain thus thrown upon the other limb may fracture the other patella also,

so that *both patellæ* are broken. If the patient seizes the stair rail he may not fall down, and because he does not fall it is sometimes difficult to persuade either him or the bystanders that the bones can be broken.

The *signs and symptoms* of a fractured patella are: (*a*) Helplessness of the limb; (*b*) the impossibility of straightening the leg; (*c*) the gap may be felt by passing the finger over of the patella; (*d*) swelling of knee.

Treatment.—(*a*) Lay the patient down; (*b*) raise the limb to half a right angle with the ground; (*c*) apply a splint at the back of the limb from the hollow below the hip to beyond the foot. (*d*) Take a narrow-fold bandage, lay its centre on the lower end of the front of the thigh above the broken bone, pull firmly downwards, cross the ends behind the splint and limb on a level with the knee, carry the ends forward, cross them over the limb just below the knee-joint, and tie off where convenient. (*e*) A second bandage is applied in a reverse fashion, commencing below the knee, crossing behind, and then tying the ends over the front of the thigh just above the broken bone. (*f*) Broad-fold bandages are now applied, one just above the middle of the thigh to secure the splint, and another to fix the splint to the foot. The bandage round the splint and foot is commenced below the waist of the boot, the ends crossed over the instep, brought round the ankle and splint and tied off either in front of the ankle or crossed again and tied under the boot. (*g*) The foot is then raised and supported on folded coats, or on a box, etc., or upon the sound limb (Fig. 30). The patient's body ought also to be raised on pillows or by a bed-rest, improvised, if need be, from an inverted chair.

Fractured Tibia and Fibula.—One or both bones of the leg may be fractured by direct or indirect violence. The tendency of a simple fracture to become compound when the tibia is broken anywhere in its shaft is very great, and is readily understood when the proximity of the bone to the skin over the front of the shin is considered. The *signs and symptoms* vary as one or both bones are broken. When but one is broken, the length of the limb is maintained by the sound bone,

but when both bones are broken the signs and symptoms presented will correspond with the details given at pp. 30-32.

Pott's Fracture.—A fracture of the leg-bones just above the ankle, termed a Pott's fracture, is of very common occurrence, and the injury is frequently mistaken for a sprain of the ankle. A Pott's fracture is usually caused by slipping and "going over the foot" upon ice, orange peel, banana skin, etc., or when going downstairs sideways. The nature of the accident is as follows: the foot is turned "under," usually upon its outer side, and the fibula is broken some 3 in. or so above the ankle-joint, the lower end of the inner side of the tibia (the internal malleolus) is chipped off, and the foot is displaced so that the sole of the foot looks somewhat inwards (Fig. 31). Swelling and discoloration quickly occur, there is great pain on any attempt at movement, with complete inability to walk.

Fig. 31. — Pott's fracture.

Treatment.—Wherever the fracture occurs in the bones of the leg, the foot is grasped, gently pulled upon, and brought into its natural position. If but one helper is present, the two feet are tied together as directed above for fractured femur (p. 40) and the splints and bandages are subsequently applied. If two helpers are present, one maintains the foot in its proper position, whilst the other applies the splints. If but one splint is available, apply it along the outer side of the broken limb; if two splints can be had, apply one on either side. The splints for a broken leg must be long enough to reach from above the knee to beyond the foot. Umbrellas, walking sticks, policemen's truncheons, rolled-up maps, or any piece of wood of requisite strength and length may be used as splints; when an umbrella is used, undo the fastener, and shake the umbrella out so that the "ribs" are loosened—the handle of the umbrella should be upwards just above the knee. The splints are secured by bandages: the

first bandage is passed round the foot and splints (*see* p. 41); the second is applied above the knee-joint; the third and fourth secure the splints to the limb, one above and the other below the seat of the fracture; the fifth is applied round both knees and splint; these band-

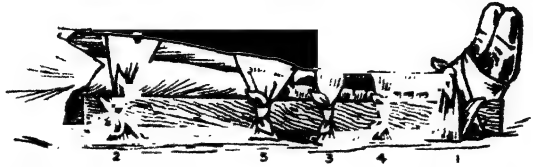


Fig. 32.—Fractured leg-bones put up by one helper.

Fig. 33.—Fractured leg-bones put up by two helpers with umbrella.

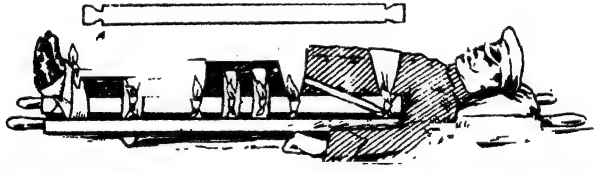


Fig. 34.—Splint for fractured thigh, with perineal band. A, notches in splint.

ages may be passed double (*see* p. 41); finally, the two limbs should be tied together by a bandage round the legs, and another round both feet (Figs. 32, 33 and 34).

Fractured Bones of the Foot.—It is seldom that the bones of the foot (tarsus) are broken; the metatarsal bones are more frequently broken when the foot has been crushed, or by a weight falling upon it. The

bones of the toes (phalanges) may also be crushed and broken.

Treatment.—Apply a flat padded piece of wood to the sole; a thick layer of cotton-wool, of folded flannel or towel is to be laid upon the upper surface (dorsum) of the foot, and the whole secured by a broad bandage carried from the sole of the foot, first over the instep, then round the lower part of the leg just above the heel, and brought back over the instep and tied on the splint on the sole.

Fractures of the Upper Extremities.

Fractured Scapula.—The scapula is rarely fractured, but a blow, as from the buffer of a railway-carriage, may crush the bone and break it into several pieces (starred fracture). The *signs and symptoms* may be difficult to make out, but when the injury is suspected, proceed as follows: (*a*) If out of doors, remove the outer garments; if indoors, bare the shoulder; (*b*) put a layer of cotton-wool, flannel, or other soft material in the armpits of both sides; (*c*) apply the centre of a broad-fold bandage beneath the axilla of the injured side, carry one end over the back, another over the front of the chest, to the top of the opposite shoulder, cross the ends and tie the knot below the armpit of the uninjured side. The limb of the injured side is then supported in a large arm sling (Fig. 35).

Fractured Clavicle.—This bone may be broken by direct violence applied to the bone itself, or by indirect violence, such as a fall on the hand, on the bent elbow, or on the outer part of the shoulder. The *signs and symptoms* are: (*a*) The limb is helpless, the patient usually supporting it at the elbow by the hand of the sound limb; (*b*) on passing the fingers along the collar-bone a gap may be felt; the outer fragment will be found on a lower level than the inner, with its end projecting forward. The other usual signs of fracture may be present (p. 30).

Treatment.—The principles of treatment in a case of fractured collar-bone are to keep the shoulder back, and to support the elbow, so that the outer fragment of the broken bone may be pulled backwards and raised.

To carry out these principles there are several plans in vogue. One (A) is as follows: (*a*) Place a pad as big as a Bath bun in the armpit of the injured side; (*b*) pull the shoulder back; (*c*) bend the elbow to a right angle; (*d*) support the limb whilst a sling is being applied. The sling in this instance should not be the ordinary arm sling, as this would cross and press upon the ends of the broken clavicle. The sling is modified as follows: Place the forearm bent at right angles to the arm across the front of the body, with a towel or cotton-wool interposed between the hand and forearm, and the chest

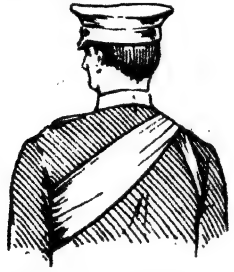


Fig. 35.—Bandage for fractured left scapula.

Fig. 36.—Bandage for fracture of both clavicles.

(this is not necessary if the shirt has not been removed). Lay an unfolded triangular bandage on the front of the chest and over the bent forearm, with one end of the bandage over the sound shoulder, and the point (apex) of the bandage over the elbow. Gather up the lower part of the bandage as it hangs over the front of the body, carry it below the limb over the back, and tie it off on the top of the sound shoulder. The apex of the bandage is pulled backwards and pinned to the bandage behind. This method of applying a sling is known as the "St. John Sling" (Fig. 96). A narrow-fold bandage is now laid across the arm of the injured side just above and over the elbow, the ends are carried one behind the body and the other in front, and the knot tied below the hand of the injured side as

it lies on the chest. The bandage round the chest should be tied quite tightly, and the sling should be subsequently made tight enough to support and raise the elbow securely.

(B) Another way of applying the sling is to commence in the usual way (Fig. 40) by laying an unfolded triangular bandage on the front of the chest with the apex beneath the elbow of the injured limb and one end over the sound shoulder. The elbow bent at a right angle is now placed upon the bandage; the lower end of the bandage hanging down in front of the body is then caught up, but instead of carrying this end over the shoulder of the injured side, it is passed beneath the armpit of the injured side just below the pad, and so up behind the back and tied off where the ends meet on the sound shoulder. The bandage round the body is then applied as already described (Fig. 40).

When but one bandage (it may be two handkerchiefs or neckties knotted together) is available, proceed as follows: (*a*) Place a pad in the axilla (*see* above), (*b*) bend the elbow of the injured limb to a right angle and place the forearm across the chest. (*b*) Apply the centre of the bandage to the outer side of the arm just above the elbow. Carry one end forwards and the other behind the body; the end behind is then brought forwards between the arm of the injured limb and the side of the body, made to form a loop (or catch) over the bandage in front, brought back again between the limb and the side, and the two ends are carried round the trunk, one in front, the other behind, and then tied just below the hand of the flexed forearm as it lies on the front of the chest.

When both collar-bones are broken, a narrow-fold bandage is passed beneath the armpit and made to form a ring round each shoulder; under either ring behind a narrow-fold bandage is slipped, and the ends are pulled tightly and tied in the middle of the back. When both shoulders are secured in position the elbows are bent, the hands crossed over the chest, and a narrow-fold bandage passed round the limbs and body just above the elbows, and the knot tied in front (Fig. 36).

Fractured Humerus.—The bone of the arm may be broken at its upper end, in its shaft, or at its lower end close to or involving the elbow-joint. When the *upper end* of the humerus is broken close to the shoulder-joint the condition is one very difficult to make out; if it has occurred or is suspected, the *treatment* is as follows: Apply a broad-fold bandage with its centre laid upon the outer and upper part of the arm and shoulder, carry the ends, one in front and the other behind, round the body to the armpit of the opposite side, there cross the ends and tie off on the top of the shoulder of the sound side; a pad of cotton wool should be placed in the armpit on the sound side. The limb is now supported by a small arm sling applied in the usual way (Fig. 37).

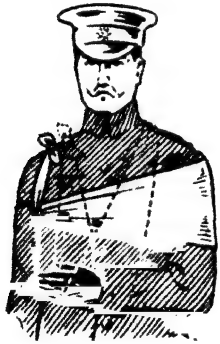


Fig. 37.—Bandage for fracture of upper end of humerus.

Fig. 38.—Bandage for fracture of shaft of humerus.

When the *shaft* of the bone is broken the *signs and symptoms* are pronounced; deformity, helplessness, pain, shortening of the arm, etc., with marked crepitus on movement, readily indicate the nature of the injury. *Treatment:* After carefully removing the clothing, support the limb while splints are being applied to the arm. (*a*) Four small pieces of wood long enough to reach from

the shoulder to the elbow are wrapped in some soft material and applied one to the front, another to the inner side, the third to the outer side and the fourth to the back of the arm. The inner splint must be shorter than the others so that it presses neither upon the armpit nor upon the forearm at the elbow when it is bent. (*b*) Above and below the seat of the fracture a narrow-fold bandage is carried round the limb so as to maintain the splints in their places, one immediately above and one immediately below the seat of the fracture. (*c*) A small arm sling is then applied to support the forearm at the wrist and hand (Fig. 38). Instead of wooden splints, two small flexible books (with paper covers) may be bent and applied lengthwise around the seat of the fracture so as to support the humerus in its entire length, and secured by bandages in the usual way. Folded newspapers may be used in place of the books or wooden splints (Fig. 38).

Fracture of the *lower end* of the humerus generally extends to the elbow-joint. There is swelling of the parts in and around the joint, pain, deformity, etc., and marked crepitus. *Treatment:* (*a*) The forearm should be bent at a right angle to the arm; (*b*) two flat pieces of wood, one about 9 in. in length, the other about 18 in., should be laid one upon the other at one end crosswise; the splints at the cross are then tied together at a right angle by a narrow piece of bandage, a handkerchief, or a piece of broad tape, and padded; (*c*) the angular splint thus made is laid on the inner side of the limb and secured by narrow-fold bandages round the arm, the forearm, and the hand, the limb being then supported by a narrow arm sling. Should the skin of the inner side of the limb be injured or inflamed, the angular splint may be applied on the outer side of the limb (Fig. 41).

Fractured Radius and Ulna.—One or both of these bones may be broken by direct or indirect violence. When the *tip of the elbow* (the olecranon process of the ulna) is broken, the fact may be ascertained (*a*) by feeling a gap in the bone at the back of the tip of the elbow when the fingers are passed over it; (*b*) by noting that the elbow is powerless and cannot be

straightened; and (*c*) by the general indications of fracture (*see* pp. 30-32).

Treatment.—When the *tip of the elbow* (olecranon) is fractured the limb should be put up in a straight position, with a padded splint, reaching from the middle of the arm to the wrist, laid along the front of the limb, which is secured to the side of the body if out of doors, or laid flat upon a pillow when at home. When the fracture occurs in the *shaft* of either bone, (*a*) bend the elbow at a right angle; (*b*) place the hand with the palm looking towards the front of the body and the

Fig. 39.—Bandage for fractured radius and ulna.

Fig. 40.—Bandage for fracture of right clavicle.

thumb upwards, that is, with the radius and ulna, midway between pronation and supination (p. 16), in which position the bones of the forearm are most widely apart; (*c*) lay padded splints, one upon the outside and one upon the inside of the forearm, the outer splint extending from beyond the elbow to the knuckles, the inner one from beyond the elbow to beyond the tips of the fingers; (*d*) secure the splints in position by narrow-fold bandages carried round the forearm and the splint, one above the seat of the fracture and the other below. A third bandage should be made to secure the hand to the splints. The forearm is then supported by a large arm sling (Fig. 39).

Colles's Fracture.—Of the two bones of the forearm, the radius alone supports the hand; therefore, in a fall on the hand it is on the lower end of the radius that the strain falls. A fracture of the *lower end of the radius* s termed a Colles's fracture, and it is of the nature of an impacted fracture (Figs. 42 and 42a). The *signs and symptoms* are not always convincing, and the injury is frequently regarded as a sprain of the wrist. It will be noticed, however, that the seat of the pain is above and not at the wrist, that there is a deformity of the bone, irregularity in its outline, and that the hand is tilted towards the thumb (radial

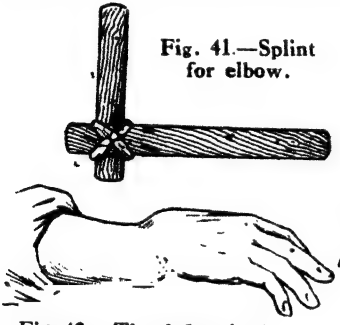


Fig. 41.—Splint for elbow.

Fig. 42.—The deformity in Colles's fracture.

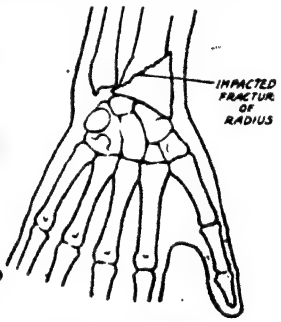


Fig. 42a.—Colles's fracture.

side). A fracture in this position is put up in the first instance as for ordinary fracture of the shafts of the forearm bones (*see* above). The doctor will replace this afterwards by a special splint for Colles's fracture.

The Hand.—When the hand is crushed the carpal bones are but rarely broken, but one or more metacarpal bones are not uncommonly the seat of fracture; sometimes in boxing a metacarpal bone is broken; it is the metacarpal bone of the ring finger that usually breaks on these occasions.

Treatment.—Lay the hand upon a padded piece of wood, a stiffly folded newspaper, or a strip of linoleum, and secure by a narrow-fold bandage carried figure-of-

eight fashion round the hand and wrist; afterwards support the hand in a narrow arm sling (Fig. 43).

Finger-bones.—When the bone of a finger is broken, apply a narrow padded splint along its front, extending from the palm of the hand to beyond the tip of the injured finger. The whole finger and splint is en-

Fig. 43.—Bandage for fractured metacarpal bones

veloped in cotton wool and a piece of tape is then wound round the finger, commencing from the tip; the hand is supported in a narrow arm sling.

Fractured Ribs

Fractured Ribs.—A rib or ribs may be broken (*a*) by direct violence from a blow, or a fall upon the chest; or (*b*) by indirect violence, as when the chest is crushed, say, between railway carriage buffers. When crushed the rib may break at some distance from the seat of impact. When only one or two ribs are broken the displacement is not great, owing to the ribs above and below maintaining the rigidity of the chest wall. There is, therefore, little likelihood of the lung being injured where but one or two ribs are broken, but should a number of ribs be broken, as when a cart wheel passes over the chest, there is great danger of the broken ends being driven inwards, and the lung being torn. When a rib is broken the *signs and symptoms* are usually quite apparent: (*a*) There is severe pain on deep breathing or on coughing; (*b*) the patient can usually indicate the exact spot at which the fracture has occurred; (*c*) when the hand is laid upon the seat of the pain, and a deep breath is taken, crepitus may be felt.

Treatment.—(1) When the lung is not injured undo the clothing, apply a broad-fold bandage round the chest, the centre of the bandage being over the upper

part of the spot complained of (Fig. 44). The ends are brought round the chest to the opposite side and tied towards the front of the sound side of the chest, in a line with the nipple. A similar bandage is applied so as to overlap the lower half of the one previously applied; the ends are tied immediately below the knot of the first bandage. The lower bandage is to be pulled sufficiently tight to give comfort by its support to the patient, and allow of at least shallow breathing without much discomfort. The forearm on the injured side should be supported in a large sling.

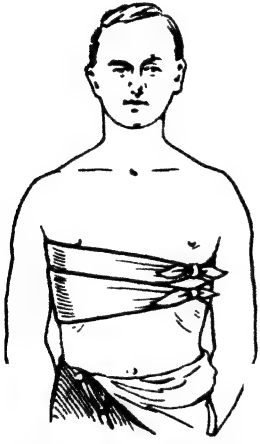


Fig. 44. — Bandage for fractured ribs.

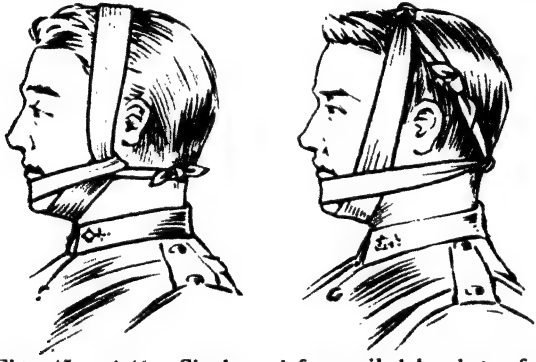
(2) When the lung is injured, blood of a frothy appearance and bright-red colour is coughed up. Do not apply a bandage round the chest, as there is a danger of driving the broken ends of the rib still farther into the lung. Instead, loosen the clothing, lay the patient down, incline him towards, but do not roll him on to, the injured side, give ice to suck, and a sufficiency of ventilation. A piece of ice may be laid over the seat of pain.

Fractures of the Skull

Fractured Lower Jaw.—The lower jaw is the most frequently broken bone of the skull. A blow upon the bone may cause a fracture of one side only, or, if very severe, of both sides. The *signs and symptoms* are apparent: (*a*) Pain on movement of the jaw; (*b*) irregularity of the teeth; (*c*) hæmorrhage from the gums; (*d*) crepitus when any movement is made; (*e*) dribbling from the mouth; and (*f*) difficulty in speaking, eating and swallowing, will afford evidence of what has happened.

Treatment.—The fragments of the broken lower jaw may be kept together by a four-tailed bandage, by two triangular bandages, or by a single triangular bandage. No splint is necessary, as the upper jaw affords a natural splint against which the lower jaw is held in place by bandages.

1. *Four-Tailed Bandage.*—Apply the hole cut in the centre of the bandage over the chin; carry the two lower ends to the top of the head and tie them there; bring the two upper ends horizontally back-



Figs. 45 and 46.—Single and four-tailed bandages for fractured lower jaw.

wards and tie at the back of the head. Finally tie the two right ends of the two bandages together, and then the two left ends: the knots should be made towards the top of the head and not on the part of the head at the back where it lies on the pillow.

2. Two triangular bandages (handkerchiefs) may be employed to secure the lower jaw. One above the chin passes to the back of the head, where the ends are tied, another passes below the chin and is carried to the top of the head and tied. The ends of the two bandages are tied together as in the case of the four-tailed bandage (Fig. 46).

3. A single triangular bandage or two handkerchiefs knotted together may be applied as follows: Suppose it

is the right side of the lower jaw that is broken, the crossings should be made on the opposite (left) side. A broad or narrow-fold bandage may be used. Lay a broad-fold bandage on the top of the head so that one end hangs down on one side, say, the left, four inches below the left ear. The other, the long end, is carried down over the right side of the head below the lower jaw to the angle of the jaw on the left side. The long end is now passed underneath the short end and brought forward above the chin, and tied to the short end just below and behind the left ear (Fig. 45). The bandage should be pulled sufficiently tight to press the lower jaw firmly against the upper jaw, which serves as a splint for the broken bone. The patient is given fluid food only—milk, beef tea, coffee, tea, etc.—for three or four weeks.

Fractured Upper Jaw.—This bone is rarely broken, but the presence of fracture may be recognised either by feeling the crack in the bone where it supports the cheek, or from irregularity of teeth. If the teeth of the upper jaw are found to be irregular, bandage the jaws together as for fracture of the lower jaw; if there is no irregularity no bandage is necessary. The **nose** may be broken, when its altered shape and appearance will indicate what has happened. The deformity may be left to a doctor to remove, or the bones may be raised into place by passing a pencil up the nostrils and raising them into position.

Fracture of the bones of the jaw, nose, or forehead not infrequently allows of the escape of air beneath the skin which tends to ascend to the scalp and temples. This condition, termed *surgical emphysema*, is not necessarily a dangerous complication. The presence of the air is indicated by crackling when the fingers are pressed upon the part where the air has reached; the part looks puffy and pale.

Fractured Cranial Bones.—Fracture of the bones of the cranium is discussed in connection with injuries to the brain (p. 132).

Sprains

When a joint is wrenched, or twisted, the structures entering into its formation may be seriously injured.

Signs and Symptoms.—When a joint is sprained there will be (1) acute pain; (2) swelling; (3) some deformity; (4) effusion of blood and discoloration; and (5) loss of power in the joint. Of the parts entering into the formation of the joint, the *ligaments* are the chief structures affected. One or more of the ligaments are stretched, or torn completely through, allowing thereby of some separation and displacement of the bones entering into the formation of the joint. The synovial membrane is torn, blood is effused and will find its way into the joint, and into the tissues around for some distance above and below. The presence of the blood will be evident soon after the accident by

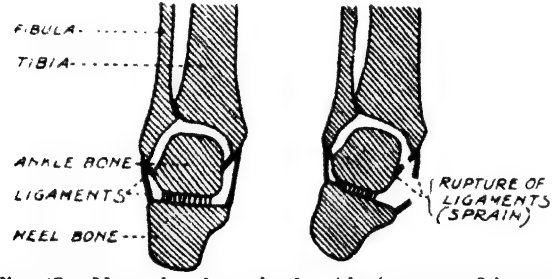


Fig. 47.—Normal and sprained ankle (rupture of internal ligaments).

the appearance of discoloration over a considerable area. The discoloration may continue for weeks, gradually passing from a red to a purple appearance, and afterwards fading away to a greenish-yellow colour (*see* Bruises, p. 112).

Sprained Ankle.—As a concrete example of a sprained joint a sprained ankle will suffice. Although almost any joint may be sprained, this joint is more frequently the subject of sprain than any other. On twisting or "going over the ankle," one of two things may happen: either the bones may be broken (*see* Pott's fracture, p. 46), or the ankle may be sprained. It is usually the ligaments on the outer side of the ankle that give way, owing to the fact that when one

"goes over the ankle," the outer side of the foot is turned underneath. The swelling occurs first on the outer side of the ankle, that is, just over the torn outer ligament, but soon the whole area around the ankle is involved, and the discoloration is apparent after a few days for a considerable distance, it may be from toes to knee. In Fig. 47 the inner ligaments are torn.

Treatment.—The principle of immediate treatment to be followed in the case of a sprain is to apply a bandage to take the place of the torn ligament in maintaining the bones in apposition and thereby support the joint. In the case of the ankle proceed as follows:

Out of doors.—Should an ankle be sprained at some distance from home, (*a*) do not remove the boot or sock, but lace up the boot more tightly. (*b*) Apply the centre of a bandage (strap, belt, or two handkerchiefs knotted together) below the sole (waist) of the boot, cross the ends over the instep and carry them round and round the ankle and lower part of the leg, securing them quite firmly. The patient, if alone, may accomplish this himself, and may either wait for assistance, or if in a lonely district he may be able, after tying up the ankle, to walk with the help of a stick to the nearest house. (*c*) Cold water, if it can be obtained, is poured over the bandage and foot, or the bandaged foot may be dipped in a pool or bucket of water. By so doing, not only is the bandage tightened by being wetted, but the cold helps to relieve the pain. (*d*) To assist the patient to shelter (supposing it is the left ankle that is sprained), the helper stands on the left side of the patient (that is, on the same side as the injury), brings the patient's left arm over his (the helper's) left shoulder, tucking his right shoulder beneath the patient's left axilla. The helper now grasps the patient's left wrist with his (the helper's) left hand; passes his right arm round the patient's waist so that the hand appears well forward on the patient's right side on a level with the haunch-bone. In this position, if the patient raises his left foot from the ground, he can, with the assistance of the helper, hop along on the right foot quite quickly (Fig. 110), even at a running pace. The helper, by bringing the patient's weight on his right side, can

carry the patient over obstacles, or for a considerable distance if the patient is faint.

Indoors.—On reaching shelter the patient is laid on a couch or bed; the boot is carefully removed, cutting the lace and leather if need be; the sock is cut from the top to the toe, so that it falls off without pulling; the foot is then raised upon a pillow or cushion, and wrapped up in a large towel wrung out of cold water, so that the limb is enveloped from the toes to half way up the leg. If ice is available, the towel may be wrung out in ice-cold water, or an ice-bag may be laid upon the sprained ankle; and the cold may be maintained by squeezing water from a wet sponge over the towel enclosing the foot from time to time. When the cold water ceases to give comfort, apply hot water in the form of a hot fomentation, or a hot bran poultice.

A *hot fomentation* is made by wringing a piece of flannel, or a towel, out of hot water. After applying it to the part, cover over with a large dry bath towel, or a piece of mackintosh or jaconet. A *bran poultice* is made as follows: Over a basinful of bran pour boiling water in sufficient quantity thoroughly to soak the bran; turn the wet bran on to a towel, strain the water off, and opening out the towel, lay the foot in the bran, covering the limb from the toes to well above the ankle; a tablespoonful of vinegar sprinkled over the bran is useful, inasmuch as the acid (acetic) of the vinegar combined with the moisture and steam from the poultice gives a sort of acid bath, which is comforting.

Support the foot on pillows, etc., and tie the pillows to the limb so that it is prevented from slipping. As a Pott's fracture is frequently mistaken for a sprained ankle, a doctor should be called in as soon as possible.

When a sprain occurs at other joints, such as the knee, elbow, or wrist, the same principles of treatment are to be followed, but a splint should be applied to ensure the joint being kept at rest.

Strains

By sudden movements, by a wrench, or by lifting heavy weights, muscles or tendons (leaders), especially in the limbs, may be stretched and torn, or in other

words "strained." Some blood is effused at the seat of the injury, followed by pain, cramp, and stiffness of the part. When the strain is in a limb, the pain will be relieved by hot applications, such as a hot omentation or a bran poultice (*see* p. 61), and it may be necessary to apply a splint to keep the joints immediately above and below the injured muscle at rest. Discoloration will probably ensue at a subsequent date. When the strain is in the back it usually occurs in the loins. In applying a bran poultice to the loins it is well to make a muslin bag in which the hot moist bran may be placed before it is applied. It is usually some two or three weeks before the effects of a severe strain completely pass off.

Rupture.—Another variety of so-called strain, occurring usually in the region of the groin, is of a more serious nature. Here it is not a muscle or tendon that is injured, but one of the contents of the abdomen, usually the bowel, protrudes through the wall of the abdomen beneath the skin immediately above or below the fold of the groin; above the groin is the more common situation in men, below the groin in women. Should such an accident occur, the patient feels that something has given way; pain may be acute, swelling in the neighbourhood of one groin may be present, and the patient finds relief by bending the knee and the thigh on the side affected, so that the limb is drawn up against the body. Vomiting may occur soon after the accident.

Treatment.—Lay the patient down with the head and trunk well raised, and with the thigh of the affected side well drawn up against the body; an ice-bag or cloth wrung out of cold water should be placed over the swelling and a doctor sent for at once. His immediate attendance is imperative.

Dislocations

Displacement of a bone at a joint constitutes a dislocation. Of all the joints in the body, the **shoulder-joint** is the one most frequently dislocated. The anatomy of this joint explains its liability to dislocation. At the shoulder there is a large rounded ball of

bone (the head of the humerus) lying against a small, shallow, saucer-like surface (glenoid) on the blade-bone (scapula); and the frequent violence to which this joint is subjected will serve to explain why the large ball so readily escapes from the shallow surface against which it lies (Fig. 17, p. 21).

Signs and Symptoms.—Taking the shoulder-joint as an example, the signs and symptoms of dislocation are:—

1. *Pain at the Joint.*—The pain is of a sickening, distressing character, often causing a feeling of faintness.

2. *Deformity.*—This will be seen when the shoulder is bared. Supposing the head of the humerus is dislocated forwards—the usual occurrence, there will be a swelling in front and a hollow behind the joint, and the muscles of the shoulder will feel tense and hard.

3. *Swelling.*—Blood will be effused into and around the joint owing to the blood-vessels in the tissues and the muscles covering it being torn.

4. *Fixity of the Joint.*—All the usual movements of the joint are rendered impossible either to the patient or to the bystander. On attempting to move the dislocated limb the body will be found to move and not the shoulder-joint.

5. *Abnormal Position of the Limb.*—It will be found that the elbow cannot be brought to the side of the body, and that the limb does not hang in the usual position, namely, parallel to the side of the body, but the elbow is bent, and the limb is carried backwards or forwards according to the position of the head of the bone.

6. *Shock.*—The features become pallid, the patient feels chilly, the temperature is lowered, and the pulse weakened.

Treatment.—The treatment of a dislocation will be best explained by continuing to take a dislocated shoulder as a typical example.

Out of Doors.—When a dislocation of the shoulder occurs at a distance from home proceed as follows: (*a*) Ease the patient's clothing if uncomfortable; it is not necessary to remove it, but if the coat has been removed to ease pain (*see* below), it must be thrown round the patient's shoulders to prevent chill. (*b*) Maintain the

limb in whatever position is most comfortable to the patient; he will assuredly hold the limb in the position which gives him most relief, and without disturbing the limb or moving it from that position, secure it against the side by appropriate bandages. If he finds most relief by the arm being placed across the front of the body, or downwards along the side, or with the hand resting on the hip behind, tie the arm to the side in any one of these several positions by one, two, or more bandages carried round the injured limb and the body. With the arm thus secured, pain on movement, as on horseback, in a vehicle, or on walking, will be reduced to a minimum. As the elbow cannot be brought to the side it gives comfort to interpose a pad (folded coat or hand bag) between the elbow and the side of the body, before applying bandages.

Indoors.—On arriving at home the clothing should be removed; the coat, waistcoat, shirt and undervest are taken off, by cutting if necessary, so that the shoulder of the injured side is bared. To remove a coat: When, say, the left shoulder is dislocated, begin by taking the arm out of the right sleeve, i.e. the sound side in this case, and then gently slip it off from the left—the injured side. The same may be done with the shirt and undervest, but as a rule it is better to cut these. The patient is to be laid down and the limb maintained in the position most comfortable to him, laying it across the body if so preferred, or placing it on pillows by his side, etc. Cold or hot applications, according as the patient prefers, are kept upon the shoulder until the doctor arrives.

A shoulder once dislocated is apt to slip out again, and in some cases, when subjected to certain forms of strain, repeatedly. In such cases the patient, being conversant with what to do, may ask a bystander to help by pulling the limb in a certain direction; in such exceptional circumstances the dislocation may be treated without the help of a doctor, but under no other conditions should attempts be made to replace the bone (reduce the dislocation) except by a doctor.

Of the other joints of the body, the elbow and lower jaw are the most frequently dislocated. The elbow

joint is treated on the principles given above, viz. keeping the forearm extended, slightly bent or fully bent according as the patient prefers, and supporting it in one of these positions until the doctor arrives. For dislocation of the **lower jaw** a handkerchief with its centre over the tip of the chin and tied on the top of the head will steady the part (no more can be done) until the doctor arrives. A dislocation occurring at any one of the **finger-joints** is frequently reduced by the patient pulling upon the finger at once, or asking a bystander to do so. If this is not done at once, i.e. within a minute or two after the accident, a doctor's services will be required. Dislocation of the **thumb** is more difficult to reduce, and will certainly require a doctor's help; meantime, wrap the dislocated thumb in a wet handkerchief to relieve pain.

Dislocation of the **patella**, often called popularly "dislocation of the knee," is not an uncommon occurrence. If the patella has been "out" on several occasions previously, the patient may reduce the dislocation himself, either by pushing the bone into place when the knee is straight, or by bending and then straightening the limb. The bystander, however, beyond helping the patient in his efforts on these occasions, should not attempt to reduce the dislocation, but proceed as follows: Maintain the limb by bandages or splints applied so as to keep it at rest in whatever position (bent or straight) the patient finds comfortable, apply cold water dressings, and get a doctor as soon as possible.

Compound Dislocation.—When a bone slips from its socket and the dislocated end of the bone protrudes through the skin, the condition is termed a compound dislocation. The treatment to be adopted is to (*a*) cover the end of the protruding bone with a clean dressing, such as lint or a clean handkerchief wrung out of boiled water; (*b*) envelop the joint in cotton-wool, or other soft material; and (*c*) maintain the limb at rest, by a splint if need be, in the position the patient finds most comfortable.

CHAPTER V

THE BLOOD CIRCULATORY SYSTEM

THE circulation of the blood throughout the body is carried on by the heart and blood-vessels, and a short account of these is necessary in order to understand aright the means whereby the flow of blood from a cut or ruptured blood-vessel may be arrested.

Briefly, the blood is driven by the heart to the arteries, whereby a supply of pure (red or arterial) blood is conveyed to the organs and tissues of the body. In the organs and tissues the arteries end in microscopic vessels named capillaries, in which, owing to the interchange of gases, namely, giving up oxygen and receiving carbonic acid, the blood is changed in colour from red or arterial (pure) blood to a dark-blue colour (venous or impure blood). From the capillaries the dark-blue blood is conveyed by the veins back to the heart. These several structures must be considered more closely, after some account has been given of the blood.

THE BLOOD

When blood issuing from a cut in the skin comes in contact with "foreign" material, such as the skin itself, clothing, the floor, a dish, a knife, etc., it speedily clots. Clotting of the blood is spoken of technically as "coagulation," and during the process of coagulation the blood is seen to separate into fluid and solid portions. If this process is viewed in a tall glass vessel, such as a test-tube, the fluid is seen on the top, and a solid mass falls gradually to the bottom of the tube (Fig. 48). The fluid part is termed the *serum* of the blood, and is of a pale, transparent "straw colour," resembling the fluid met with in a blister. The solid part or clot consists of a gelatinous-looking material termed the "fibrin," and entangled in the fibrin are the blood cells or "corpuscles," the red and white (Fig. 49).

In the living body the fibrin is in the fluid state, and is dissolved in the serum, when the serum and the dissolved fibrin are termed the *liquor sanguinis*, or fluid of the "live" blood. A familiar example of similar conditions is met with in the case of an egg. In the uncooked egg, the white part of the egg (albumin) is fluid in character, but when boiled the white part becomes a solid, firm mass. Beef tea, again, when warm is fluid, but when cold it "sets" or solidifies. From these examples it is seen how both cold and

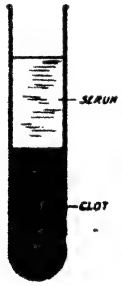


Fig. 48.—Fluid and solid portions of the blood.

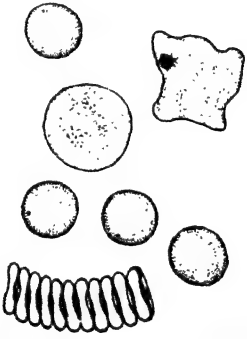


Fig. 49.—Blood corpuscles.

heat cause coagulation, and the explanation of how heat and cold applied to a bleeding surface arrests the flow is afforded.

The coagulation of the blood plays an important part in arresting hæmorrhage and in healing wounds. Over a cut in the skin the blood coagulates and forms a scab or crust, arresting the further issue of blood and allowing of the healing of the wound beneath. Within the cut blood-vessel and around its cut end the blood also coagulates and plugs the mouth of the bleeding vessel. This is nature's method of arresting hæmorrhage; and, unless the blood-vessel is of so large a size that the loss of blood is enormous, it is generally successful in stopping the flow.

The Heart

The heart is the central organ of the blood circulatory system. In size it corresponds in each individual to about the dimensions of his or her clenched fist. The heart lies in the chest (thorax), having the breast-bone (sternum) in front, the spine behind, and the right and left lungs on either side respectively; beneath, it

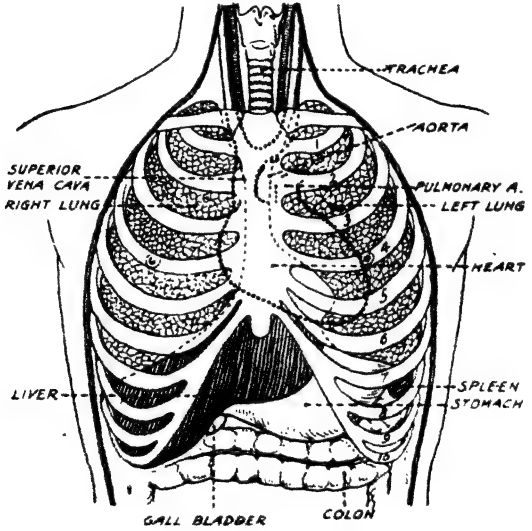


Fig. 50.—Relation of the heart to neighbouring organs.

rests on the upper surface of the diaphragm (midriff). Conical in shape, the heart lies obliquely with its point (apex) directed downwards and forwards, and approaches the chest wall just below and internally to the left nipple, where the beats of the heart may be felt. The base is directed upwards to the right. The oblique position is such that one-fourth of the bulk of the heart lies to the right of the middle line of the body and three-fourths to the left (Fig. 50).

Around the heart is a stout fibrous bag termed the *pericardium*, and within the "fibrous pericardium" is the "serous pericardium," a delicate membrane of two layers, one covering the heart itself, the other the inner surface of the fibrous pericardium so as to form a sac, which encloses a small quantity of clear (serous) fluid to allow of the movements of the heart within the pericardium without friction.

The heart presents four chambers, the walls of which are composed of special muscular fibres termed "heart

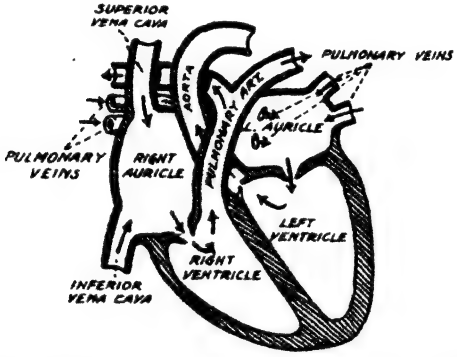


Fig. 51.—Section of the heart, showing the auricles and ventricles, arteries, and the course of the blood.

muscle," being intermediate in character between the voluntary and involuntary muscles (*see* p. 26). The four cavities are divided by a central partition running vertically from the base of the apex of the heart, so that it is divided into a right and a left side; each side again is divided into an upper and a lower cavity (Fig. 51). The two on the left side have walls three times as thick as those of the right; the reason for this difference being that, whereas the blood from the right side of the heart is carried merely to the lungs and back, the blood from the left side has to be driven through the whole body and back to the heart again.

The technical names of the four regions of the heart are the *auricles* and the *ventricles*. The two upper chambers are named the right and left auricles, and the two lower chambers the right and left ventricles.

(1) *The right auricle*—to begin with this—receives the venous blood from all parts of the body from (*a*) the superior vena cava (Figs. 51, 52), which conveys blood received from the upper part of the body—the head and neck and the upper limbs—and enters the upper part of

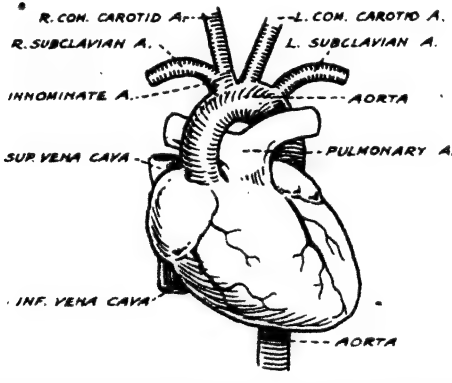


Fig. 52.—The heart, showing the arteries and veins.

the right auricle; (*b*) from the inferior vena cava, which conveys the blood from the lower part of the body—the abdomen and lower limbs—and enters the lower part of the right auricle. When the auricle becomes distended with blood the muscular walls contract and the blood is driven downwards into

(2) *The right ventricle.*—When this is distended, it contracts, but owing to the arrangement of valves the blood cannot pass back to the right auricle from the right ventricle, as the valves close, but instead it is driven upwards by the pulmonary artery to the lungs. The pulmonary artery divides into two branches, one for

each lung; these branches, on reaching the lungs, divide into smaller and still smaller branches until they end in capillaries, in which the blood they contain is exposed to the air and purified (*see* p. 74). When purified, the blood, now changed from a dark-blue colour (venous blood) to a scarlet colour (red or arterial blood), is conveyed by the four pulmonary veins to

(3) *The left auricle*, from whence it passes to

(4) *The left ventricle*, and for the same reason as in the case of the right side of the heart—namely, the closure of the valves (mitral) between the left auricle and left ventricle—the blood is driven onwards and upwards into the aorta, and thence to the whole body.

From the above description it will be seen that the auricle and ventricle of the right side act together, as also do the auricle and ventricle of the left side. There are, as it were, two hearts, a right and a left, lying in contact with a partition between them; and it will be further observed that the right chambers contain the blood returned by the veins (the venous blood), whilst the left chambers contain red or arterial blood returned from the lungs.

The action of the heart consists in the filling and emptying of its chambers. When a chamber is distended it contracts and drives the blood onwards; the valves guarding its various apertures shut with a snap, and the noise they make constitutes the "sounds of the heart" one hears when one places the ear over the heart, or they can be felt when one runs or engages in violent exercise, and at times, also, at night when one's head is on the pillow. The noise has been described as resembling the sounds "lup-dubb," repeated again and again. The interval between the "lup" and the "dubb" is short, but between the "dubb" and the next "lup" a longer interval occurs.

Blood-Vessels

Arteries.—An artery is a blood-vessel which conveys blood *from* the heart to the organs and tissues of the body. An artery of medium size, such as the main arteries in the limbs, possesses three walls: (*a*) An external (or outer) coat of fibrous tissue; (*b*) a middle

coat, chiefly of a muscular nature; (*c*) an internal coat composed, for the most part, of elastic tissue. Outside the three walls is a sheath of fibres which connects the vessel with the surrounding tissues, and internally the artery possesses a layer of flattened cells which present a smooth surface to the blood (Fig. 53). When an artery is cut or torn the coats of the vessel behave in a characteristic fashion. The outer coat is dragged out

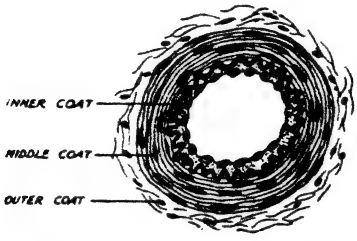


Fig. 53.—An artery, showing the walls or coats.

Fig. 54.—A torn artery.

and hangs long and uneven, the middle coat (muscular) contracts, and the inner coat (elastic) retracts (Fig. 54). The mouth of the vessel is thereby narrowed, blood clot accumulates around the bleeding point, and the hæmorrhage is gradually arrested as the narrowing increases and the clot thickens.

Veins.—A vein is a blood-vessel which conveys blood *to* the heart from the organs and tissues of the body. Veins are styled, according to their situation, deep and superficial. (*a*) *Deep veins* accompany the arteries, and take the name assigned to the corresponding arteries; thus the femoral vein accompanies the femoral artery, the radial vein the radial artery. (*b*) *Superficial veins* run in the tissues immediately under the surface, and in many parts of the body they are plainly seen as blue streaks beneath the skin. They accompany no arteries, but pursue a separate course. Of the superficial veins the largest and most prominent are (1) the *jugular veins* in the neck; (2) the *saphenous*

veins in the lower limb, which, commencing at the foot, can be traced upwards along the leg to the back of the knee, and up the thigh to the groin. The saphenous veins are of great surgical importance when they become varicose—i.e. distended (*see* p. 55).

The veins in their structure resemble the arteries in possessing walls composed of fibrous, muscular, and elastic tissue, but the walls are less thick and less

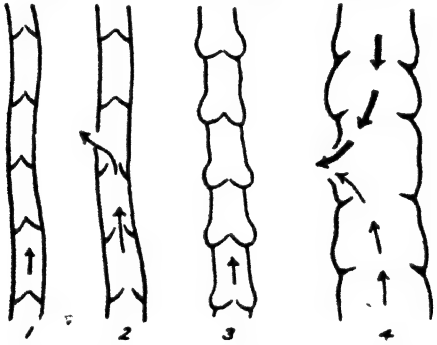


Fig. 55.—Valves and wounds of veins.

1, Vein with valves. 2, Course of blood coming from lower end of cut vein. 3, Varicose vein. 4, Wound in varicose vein, showing how blood may flow from both ends.

muscular. A characteristic feature of the veins in the limbs is the presence of valves within their walls (Fig. 55). These valves have their free edges directed towards the heart, and are so arranged that the blood can pass onwards towards the heart; but when, for any reason, the trunk of the vein is pressed upon and the current of blood within it is stemmed, its backward course is prevented by the valves closing.

All the veins of the body are collected into two large trunks, the *superior* and *inferior vena cava*, which, as mentioned above, empty their contents into the right side (auricle) of the heart. The former collects the blood from the head and neck and upper limbs; the latter collects the blood from the lower limbs, the abdomen and thorax.

Capillaries.—The word capillary is derived from the Latin word *capillus*, signifying a hair. But the capillaries are much finer than hairs. As the arteries become gradually smaller in their course, until at last they are lost to sight, they will be found, when examined with a microscope, to lose their fibrous, muscular and elastic walls, and to end in the fine vessels named capillaries (Fig. 56). The walls of the capillaries are composed of cells (endothelial cells) only, laid out like paving stones, edge to edge, and presenting a smooth surface

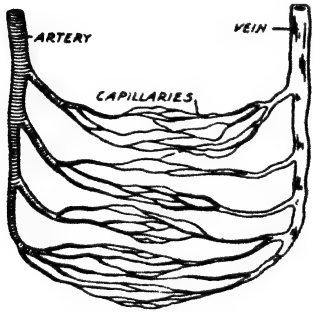


Fig. 56.—Relation between artery, capillaries and vein.

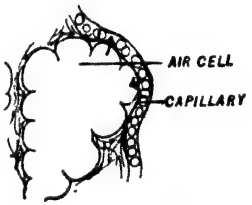


Fig. 57.—Air cell and capillary.

to the blood. To the capillaries, then, arteries convey the blood and from the capillaries the blood is gathered up by veins and conveyed to the heart and lungs to be "purified."

The Circulation of the Blood

There are three varieties of blood circulatory systems in the body.

1. The *general system*, which includes the blood-vessels of the whole body with the exception of those peculiar to the lungs and the liver. In this system the left side of the heart (left ventricle) is the motive power, and by it the red or arterial blood is driven into the arteries and capillaries, and the venous blood is gathered

from the capillaries and sent along the veins to the right auricle of the heart.

2. The *pulmonary (lung) system* consists of the blood-vessels entering and leaving the heart for the passage of the blood through the lungs. The right ventricle is the motive power for the pulmonary system, and by it the dark-blue (venous) blood is driven through the pulmonary artery to the lungs, where it ends in capillaries (Fig. 57), and thence the red (pure) blood is sent along the pulmonary veins to the left auricle of the heart. It will be seen that the pulmonary artery contains dark-blue venous blood, and the pulmonary veins red or arterial blood. It is for this reason that an artery is defined as a vessel carrying blood from the heart and a vein as a vessel carrying blood back to the heart. This is the only correct definition, as it will be seen that in the general system the arteries contain red or arterial blood and the veins dark-blue or venous blood, but in the pulmonary system the opposite obtains, the arteries containing venous blood and the veins red or arterial blood.

3. In the *portal (liver) system* a large vein enters the liver, carrying blood from the stomach and intestines, the spleen and pancreas, and there breaks up into branches which end in capillaries. From the capillaries the blood is again collected into a large vein, the hepatic (or liver) vein, which discharges into the inferior vena cava just before this passes through the diaphragm to the heart.

The Pulse.—As the blood is driven from the heart into the arteries a rise in blood pressure is caused throughout the whole of the arterial system, and it is this rise in blood pressure which occasions the pulse. The number of beats and the strength of the heart govern the rate and strength of the pulse; hence by feeling the pulse a knowledge of the heart and its work is obtained. Anywhere in the body where an artery can be compressed against a bone, a pulse may be felt. It is usual to feel the pulse by placing the fingers on the radial artery just above the wrist, but the pulse can be felt and its rate estimated in many other parts of the body besides.

The number of contractions of the heart determines the rate of the pulse; the average rate in adults is given as 72 beats to the minute, but the rate varies according to position. When the body is in the lying-down position the pulse may beat at the rate of only 60 to the minute; when sitting, the rate may increase to about 70; and when standing, to about 80. During active exercise the rate may rise to 90 or considerably higher; between 60 and 90 may be termed a healthy rate for the pulse.

The amount of blood in the body is about 12 pints; the quantity that may be lost without fatal consequences is uncertain, but a loss of 1½ pints is serious, and one of 2½ pints would in all probability be fatal. Each cavity of the heart is capable of containing about 2 ounces of blood (nearly a wine-glassful), so that every time the left ventricle contracts a wine-glassful of blood is sent into the aorta, and as there are usually 72 beats or contractions of the heart every minute, this means that there are 72 (beats) × 2 (ounces) = 144 ounces, or 7 pints 4 ounces of blood passing through the heart every minute. It is evident, therefore, that any wound of the aorta, in any part of its course, must be speedily or almost instantaneously followed by death, and that the deep-seated position of the aorta and the rapidity of the escape of blood make it impossible to do anything to save life.

The Course of the Arteries in the Trunk and Limbs

The Aorta.—From the left ventricle arises the aorta (*see* Fig. 52), from which all the arteries of the general circulation are given off. In structure the aorta consists mainly of elastic tissue, which allows of marked distension when the blood is driven into the aorta from the heart. As the vessel leaves the ventricle there are valves (three) so arranged that the blood can pass from the ventricle into the aorta, but, owing to the closure of the valves, cannot pass backwards from the aorta to the ventricle; it is the sharp closure of these valves that causes the second sound of the heart.

The aorta corresponds in its calibre to about the dimensions of the individual's thumb. Commencing im-

mediately behind the breast-bone, on a level with the third rib, the aorta may be divided into three parts, as follow :—

1. *The Arch of the Aorta.*—As the aorta leaves the heart it passes first a little to the right of the middle of the breast-bone, then crosses to the left, and continues downwards on the left of the spine. An arch is thus formed from which the arteries to the head and neck and upper limbs are given off (Fig. 52).

2. *The Thoracic or Descending Aorta.*—Although the arch of the aorta is necessarily within the thorax, it is only the part of the vessel between the arch and the diaphragm that is technically termed the thoracic aorta. Lying on the left of the spine, the artery passes from the lower part of the chest through an opening between the diaphragm and the vertebræ to the abdomen. The thoracic aorta gives off branches to the chest wall which run along each rib—the intercostal ("inter" signifying between and "costa" a rib) arteries; besides these, small arteries are sent to the lungs (bronchial) and the gullet (œsophageal).

3. *The Abdominal Aorta.*—Entering the abdomen from the thoracic aorta, through an aperture between the first lumbar vertebra and the diaphragm, the aorta changes its name to abdominal, and gradually coming more to the front of the lumbar vertebræ, it ends by dividing into two branches of equal size, namely, the right and left common iliac arteries. The division occurs opposite the interval (intervertebral disc) between the fourth and fifth lumbar vertebræ, a little to the left of the middle line; a situation which corresponds on the surface to a point a little below and to the left of the umbilicus (navel). In the abdomen the aorta gives off large branches to the stomach, intestines, liver, spleen, pancreas, kidneys, etc.

In thin people the aorta can be felt distinctly and often violently throbbing by placing the hand on the front of the middle line of the abdomen in the neighbourhood of the umbilicus.

Iliac Arteries.—The abdomenal aorta at its lower end divides into the *right and left common iliacs.* Each common iliac artery, after a course of about two inches,

divides into (*a*) the *internal iliac artery*, which sends blood-vessels to the several organs contained in the pelvis, and to the muscles of the hip; (*b*) the *external iliac artery*, which passes along the side of the brim of the pelvis to gain the centre of the groin, at which point it enters the front of the thigh as the femoral.

Arteries of the Lower Limbs. *Femoral Artery.*—This vessel, in size about the dimensions of the fore-finger, commences at the centre of the groin, and passing down the inner aspect of the thigh, gradually gains the back of the knee-joint. A line drawn from the centre of the groin to the back part of the inner side of the knee-joint marks, in the upper two-thirds of its course, the position of the main trunk of the femoral artery. The femoral gives off large branches to supply the muscles of the thigh, and in the middle of the thigh the trunk of the artery lies in close contact with the inner side of the femur (Fig. 3, p. 5).

Popliteal Artery.—The artery of the ham, about the thickness of the little finger, is continued from the femoral and lies deeply placed behind the lower end of the thigh-bone and the back of the knee-joint. At its lower end, which is on a level with the head of the fibula, the popliteal divides into two vessels (tibials), one of which runs down the front and the other the back of the leg (Fig. 3, p. 5.).

Anterior Tibial Artery.—This vessel, about the size of a goose quill, as it comes off from the popliteal passes forwards between the tibia and fibula, and runs down the leg, deeply placed between the two bones. As it approaches the ankle, the artery lies on the front part of the lower end of the tibia, and exactly in the centre of the front of the ankle; here it changes its name to the dorsal artery of the foot.

The *dorsal artery*, about the size of a crow quill, is, then, a continuation of the anterior tibial artery. It runs from the front of the middle of the ankle over the upper part of the foot (tarsus), until it reaches the interval between the first and second metatarsal bones, where it dips down to join the vessels in the sole of the foot. Branches from this artery supply the dorsum of the foot and the toes.

Posterior Tibial Artery.—Starting from the lower end of the popliteal artery, this vessel, about the size of a goose quill, passes downwards, deeply placed among the muscles of the calf, until it gains the inner side of the ankle, where it lies midway between the tip of the heel and the tip of the bony prominence (internal malleolus) on the inner aspect of the ankle, where it may be felt pulsating; the artery is continued onwards into the sole of the foot as the plantar arteries.

The *plantar arteries*, two in number, result from the division of the posterior tibial artery in the sole of the foot. They are termed the "internal" and "external" plantar arteries, according to their position in the sole. These vessels supply the sole of the foot and toes, and one branch joins with the dorsal artery between the first and second metatarsal bones to form the *plantar arch*.

Arteries of the Upper Limbs.—The arch of the aorta, from its convexity, gives off three large trunks—(*a*) the *innominate artery*, which divides into two, one being continued onwards as the *right common carotid*, which passes up on the right side of the neck; the other as the *right subclavian artery*, which passes out over the first rib and beneath the clavicle to the right upper limb. (*b*) The second branch given off from the aorta is the *left common carotid*, which passes up on the left side of the neck. (*c*) The third branch is the *left subclavian artery*, which passes outwards to the left upper extremity in the same manner as the artery of the right side: from this point the supply of the two upper limbs is symmetrical (Fig. 52).

Subclavian Artery.—On leaving the upper part of the thorax the subclavian artery, about the size of the ring finger, passes outwards over the first rib and beneath the collar-bone to the armpit. The subclavian can be felt beating at the root of the neck just behind the middle of the clavicle. At the outer border of the first rib the artery changes its name to the axillary.

The *axillary artery*, about the size of the little finger, passes across the armpit (axilla), where it lies close in contact with the shoulder-joint, and emerges from the axilla on the inner side of the humerus to form the brachial.

The *brachial artery*, about the size of a cedar pencil, runs down the arm in a line drawn from the hollow of the armpit to the front of the bend of the elbow. When the arm is bared this line corresponds to the hollow on the inner aspect of the biceps muscle. When the coat is on, the course of the artery corresponds to the inner seam of the coat-sleeve when the coat is made taut by grasping the inner seam of the sleeve at its lower end at the wrist between the forefinger and the ball of the thumb. Just below the bend of the elbow the brachial artery divides into two vessels of about the size of goose quills — the radial and ulnar.

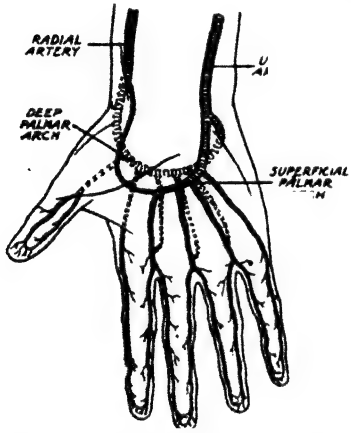


Fig. 58.—Arteries of the wrist and hand.

Radial Artery.—The course of the radial artery, when the arm is bared, corresponds to a line drawn from the centre of the bend of the elbow to the root of the ball of the thumb; when the clothing is on, this artery corresponds to the inner seam of the sleeve, if the seam at its lower end is held between the forefinger and the ball of the thumb. As the artery approaches the wrist it is continued backwards behind the root of the thumb, and then passes downwards to the interval between the first and second metacarpal bones, and passes forwards to the front of the hand to join the ulnar artery, and form the palmar arches (Fig. 58).

The pulse at the wrist is felt at the radial artery one inch above the wrist-joint and half an inch from the outer (thumb) side of the forearm.

Ulnar Artery.—A line drawn from just below the

centre of the elbow in front to the root of the ball of the little finger, in front of the wrist, indicates the course of the ulnar artery in the forearm. The ulnar artery runs forwards from the inner side of the wrist across the palm beneath the "line of life" to the outer side of the hand, where it joins the radial artery.

The *superficial palmar* arch is just beneath the skin where it is marked by the "line of life," and the *deep palmar* arch lies on the bones. The superficial arch is especially liable to be wounded. From these arches branches are given off to the fingers. The *digital arteries*, about the size of crow quills, pass along the sides of the fingers to tips (Fig. 58).

Arteries of the Head and Neck. The *Common Carotid.*—Arising from the innominate artery on the right side, and from the aorta upon the left (*see* Fig. 52), each carotid passes upwards in the neck on either side of the wind-pipe. The artery extends as high as the level of the upper border of the larynx (Adam's apple), where it divides into two trunks: (*a*) the *internal carotid* continues upwards in front of the backbone to the base of the skull, where it gains the base of the brain and divides into a number of vessels to supply the brain; (*b*) the *external carotid* artery, on its way upwards behind the back part of the lower jaw to the front of the ear, gives off branches to the tongue (*lingual artery*), to the face (*facial artery*), and to the back of the head (*occipital artery*). The *facial artery* crosses a thumb's breadth in front of the angle of the lower jaw and pursues a tortuous course round the angle of the mouth towards the side of the nose, where it ends; on either side it gives off branches to form arches (oral) in the upper and the lower lip. The *occipital artery* reaches the scalp a hand's breadth behind the rim of the ear. The main trunk of the *external carotid* is continued upwards immediately in front of the ear as the *temporal artery;* this ultimately divides into (*a*) the *posterior temporal*, which goes straight upwards towards the top of the scalp, and (*b*) the *anterior temporal*, which winds forward, just where the hair and forehead join, to reach the upper part of the front of the scalp (Fig. 74).

CHAPTER VI

HÆMORRHAGE

ACCORDING as an artery, a vein, or a capillary is wounded, the blood which escapes is termed arterial, venous, or capillary, respectively.

Signs and Symptoms of Loss of Blood.—When a large quantity of blood is lost to the body a definite series of signs and symptoms ensues.

The onset of the signs and symptoms may occur (*a*) suddenly, when the blood escapes from a large artery or vein, as when an organ so richly endowed with blood as the spleen is ruptured; (*b*) slowly, when a small artery or vein is wounded and bleeds for some time, or when an organ such as the liver or the lung is torn to a limited extent.

If the wound by which the blood-vessels are severed involves the skin, the blood will escape upon the surface of the body, when the hæmorrhage is called "external"; if the blood escapes into a cavity of the body, as into the abdomen or chest, the hæmorrhage is said to be "internal."

In whichever way the blood escapes, the signs and symptoms of the loss of a large quantity are similar. They are—(1) pallor of face and lips; (2) a feeling of weakness; (3) thirst; (4) a feeble pulse, gradually disappearing altogether at the wrist; (5) giddiness on attempting to stand or sit up: (6) a feeling of suffocation and a call for air; (7) tugging at the clothing round the neck, as if suffocating; (8) throwing the arms about and general restlessness; (9) sighing and yawning; (10) noises in the ears as of bells jangling; (11) vision becomes blurred; (12) unconsciousness may supervene; (13) the pupils dilate; (14) coma (profound insensibility).

General Treatment of Hæmorrhage:— (*a*) Lay the patient down with the head low; (*b*) arrest the

hæmorrhage, if it is external; (*c*) undo the clothing around the neck, chest and abdomen; (*d*) raise the lower limbs; (*e*) open the doors and windows of the apartment to ensure free circulation of air; (*f*) bandage the limbs with a roller bandage from the feet to the hips and from the fingers to the shoulders; (*g*) give ice to suck and cold water to sip, if the stomach is not wounded; (*h*) place an ice-bag over the seat of injury, on the chest or the abdomen if internal hæmorrhage is taking place into either cavity and the seat of the injury is known.

Varieties of Hæmorrhage.— (*a*) *Primary hæmorrhage* is the escape of blood from a blood-vessel the instant the vessel is cut. (*b*) *Intermediary hæmorrhage* is said to occur when the blood from a wound does not escape in quantity immediately the blood-vessel is cut or torn, but at some little time afterwards. The reason for the delay is usually shock due to the accident or after an operation: when the shock passes off the action of the heart strengthens and the blood from the wound begins to flow freely (*see* Lacerated Wound, p. 115). (*c*) *Secondary hæmorrhage* is the name given to the escape of blood from a wound some days or even weeks after an accident or operation. When a wound does not heal kindly, or if it gets foul and gangrene (mortification) sets in, the blood-vessels may reopen and severe hæmorrhage ensues.

ARTERIAL HÆMORRHAGE

When an artery is cut, the blood issuing therefrom has the following characteristics: (1) It is of a red colour; (2) it issues from the end of the vessel next the heart; (3) it issues in jets corresponding to the pulsation caused by the beats of the heart. These appearances will be readily understood when it is remembered, from the description of the circulation that all arteries (except the pulmonary) convey red blood from the heart to the extremities, and that a pulse occurs in every artery of the body.

According to the size of the vessel cut, so will the danger from hæmorrhage vary. When the aorta, or one of the main trunks within the chest or abdomen, is

wounded, death is "instantaneous." When the carotid, the subclavian, or the femoral artery in the neighbourhood of the groin is wounded, death supervenes in from one to two minutes unless the hæmorrhage is immediately controlled. When the brachial, the arteries of the forearm, or the arteries of the leg are cut, life is in danger, and death will probably ensue if nothing is done to check the bleeding. In hæmorrhage from the palmar arches of the hand, and the plantar arches of the foot, severe consequences would certainly occur were the hæmorrhage not speedily arrested. In the case of quite small arteries, as in the finger, toes, or scalp, nature may, by the clotting of the blood, spontaneously arrest the hæmorrhage.

It is plain, therefore, that when arteries other than quite small vessels are cut, it is imperative that means to arrest the bleeding be immediately taken.

Means of Arresting Hæmorrhage

Hæmorrhage may be arrested by natural or artificial means, or by the two combined.

Natural Arrest.—When a small blood-vessel is wounded the hæmorrhage may be arrested by the coagulation (clotting) of the blood alone. The clot occludes the wound and the open mouth of the cut vessel. Even a moderate-sized blood-vessel may become occluded partly by the clotting of the blood and partly by the contraction and retraction of the walls of the artery (*see* p. 72). Coagulation of the blood may be accelerated by (*a*) cold, in the form either of a stream of ice-cold water, of lint or pads of cotton-wool soaked in the water, or of pieces of ice applied to the bleeding-point; (*b*) hot water at a temperature of 115° F. applied as a stream or in pads on the part.

The **artificial arrest of hæmorrhage**, independently of posture, bandaging, and drugs, may be produced by digital compression, by a pad and bandage, by a pad and flexion, or by a tourniquet, of which there are several kinds.

Digital Compression. — By digital compression is meant the arrest of hæmorrhage by the application of a digit (finger or thumb) directly on the bleeding

point, or on the artery leading to the cut surface, that is, on the side of the wound nearer the heart. The thumb, from its breadth and strength, is preferable to a finger for this purpose. It is advisable to apply digital compression to the trunk of the artery instead of directly upon the wound itself. The reason for this is concerned with cleanliness, for unless the skin of the thumb or fingers is rendered sterile (clean) there is danger of poisoning the wound. Again, when a foreign body, such as a piece of glass, is left in the wound, the application of the thumb might do harm to both the patient and the helper. If, however, life is at stake the thumb should be applied at once, whenever possible, directly upon the wound. If time allows, the thumb may be covered with a clean handkerchief or a piece of clean paper, so as to avoid as far as possible the risk of poisoning the wound.

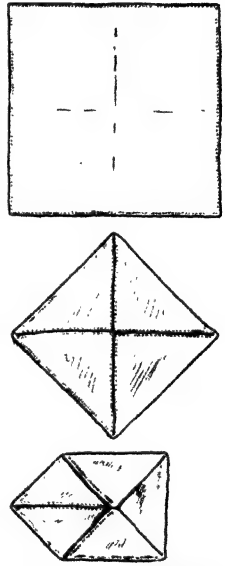


Fig. 59. — Folding handkerchief to form pad.

Pad and Bandage.—By a pad applied directly upon a bleeding-point, and secured in position by a bandage tied tightly around the limb, hæmorrhage may be controlled.

The *pad* may consist of a good-sized handkerchief (Fig. 59), which should be clean, folded into a hard ball or pad. To accomplish this, lay the handkerchief on a flat surface, bring the corners to the centre of the bandage; again bring the corners to the centre, and repeat this process until a ball is made. Put the convexity of the pad, that is the smooth rounded surface, directly upon the wound. The *bandage* may consist of a handkerchief, strap, brace, etc., made to cover the pad and encircle the limb, and tied firmly so as to press the pad tightly

on the bleeding point. Commence the bandage (*a*) over the pad, carry the ends round the limb and back, and tie off on the pad; (*b*) on the side opposite the pad, bring the ends round and twist on the pad, tie off on the opposite side (Figs. 77 and 78).

Pad and Flexion.—The brachial artery at the bend of the elbow, the popliteal artery at the back of the knee, and the axillary artery in the arm-pit, may be compressed by applying a pad over the trunk of the vessel, bending the limb so as to secure pressure on the pad, and tying the limb firmly in the flexed position so as to maintain the pressure on the pad and artery. As an example, take the popliteal artery. A pad as large as a golf ball is placed at the back of the knee, which is flexed until the heel almost touches the hip; a bandage is then carried round the leg just above the ankle, crossed so as to prevent slipping, and the ends tied round the thigh as close to the hip and groin as possible (Figs. 63 and 71).

Tourniquet.—A tourniquet consists essentially of a band to encircle the limb and of an apparatus whereby the band may be sufficiently tightened to arrest the flow of blood in the main artery leading to a wound, or to the seat of an operation about to be performed. A pad over the artery adds to the efficacy of the apparatus, and should always be used when possible.

Arresting hæmorrhage by means of a tourniquet is not unattended by danger. If the tourniquet is applied too tightly, or continued in position for too long a time, the circulation of the blood to the parts beyond the spot where it is applied may be so completely arrested as to produce mortification of the limb. The tourniquet should, therefore, be applied only just tightly enough to arrest hæmorrhage. Even so, it is necessary to relax the pressure, say every ten minutes, by untwisting the stick, and retwisting it again should hæmorrhage recur; this is repeated again and again unless help is forthcoming in the meantime.

A tourniquet should never be applied unless in case of absolute necessity. When the helper is single-handed and there are many injured to attend to, the

application of a tourniquet is justified as a temporary expedient, so that the helper may be able to go from one patient to the other.

Improvised Tourniquets.—When, after applying a pad and bandage over the course of an artery, further tightening of the bandage is required, this may be accomplished by putting a stick, a poker, a key, a penholder, a pencil, or other rod ready to hand, in the knot, and twisting it sufficiently tight to arrest the course of the blood in the artery. The apparatus used to twist the bandage must be fixed in position in such a manner as to prevent the twist becoming undone. This may be effected by tucking one end of the pencil, key, or penholder beneath a turn of the bandage (Fig. 66); or if a long stick is used, tying its ends above and below.

Before applying a mechanical tourniquet the limb should be elevated and the part stroked in a direction towards the heart, so as to empty the part of blood as much as possible. At the spot where the tourniquet is to be applied, the skin should be protected by wrapping the limb round with a handkerchief, a piece of flannel or lint, a strip of towelling, or a few turns of a roller bandage.

The Stick Tourniquet.—This form of improvised tourniquet is applicable to the arm. Take a couple of sticks 8 in. long and the thickness of the middle finger. Notch the sticks 1 in. from either end of each. Place one stick crosswise to the arm, on the inner side over the artery, and the other parallel to its fellow on the outer side of the limb. Fasten the ends of the stick firmly together by twine, tape or cord, pulling the fastening sufficiently tight to compress the brachial artery.

Elastic Tubing.—By a piece of tubing with metal hooks at either end, the arm, forearm or thigh may be encircled by two or three turns of the stretched tubing and the ends hooked together so as completely to control the flow of blood through the main arteries of the limbs.

Elastic Band.—In place of tubing an elastic band 3 in. wide by 1 yd. long may be wrapped firmly round the limb, and made sufficiently tight by stretching the band whilst it is being applied. At the free end of the band cords are attached whereby the band may be tied off.

India-Rubber Cord and Pad.—A vulcanite pad with one end of a stout rubber cord fixed in it, and a slit on its upper surface for the reception of a cord when stretched, may be used to arrest the flow of blood through the main artery of a limb. The pad is laid over the artery with the slit outwards, the cord is stretched and carried round the limb once or twice, and the stretched cord is slipped into the slit in the pad. When the cord is let go it is grasped on the slit and pressure maintained.

The Field Tourniquet.—For use in the field of battle, this simple tourniquet consists of a strap to surround the limb, a pad to be placed on the main artery, and a buckle to fix the strap when pulled sufficiently tight; it admits of being quickly adjusted.

The Screw Tourniquet (Petit) consists of a strap and buckle to surround the limb, a pad to place over the artery, and a screw apparatus to tighten the strap. The screw apparatus consists of two metal plates with two rollers at the sides of the lower plate, one roller on the side of the upper plate, and a screw with handle. To thread this tourniquet, pass the plain end of the strap upwards between the two rollers of the lower plate, round the roller in the upper plate from without inwards, carry the end downwards between the two rollers of the lower plate on the inner side of the strap already passed. The end is now made to pass beneath the strap on the upper side of the pad. The end is passed between the rollers of the lower plate on the opposite side to that already threaded, upwards over the upper roller, from within outwards, downwards between the two rollers, again on the outer side of the strap already passed, and the end pulled well through. To apply the tourniquet, place the pad over the artery to be compressed, tighten the bandage round the limb, and buckle off. With the two plates in contact, turn the handle of the screw until the apparatus is made sufficiently tight to arrest the flow of blood in the artery (Fig. 83A, p. 111).

The Anchor Tourniquet consists of an elastic cord with a piece of metal shaped like an anchor at one end. To the handle of the anchor the cord is attached; the cord is now stretched as it is carried

round the limb, and finally it is carried round the shank of the anchor, and round the two flukes.

Arrest of Hæmorrhage from the Upper Extremities

The Hand.—When a *finger* is wounded a sharp hæmorrhage may occur. It is arrested by digital pressure in the first instance, and subsequently by a pad and bandage. The pad may be a small piece of linen or lint, and the bandage may consist of a piece of tape, strip of a handkerchief, or a piece of strapping plaster. When the *palm of the hand* is wounded, especially in the region of the "line of life," beneath which the palmar arch lies, the hæmorrhage is apt to be profuse. The palmar arch is formed by the junction of two arteries, the radial and the ulnar, so that a wound of this arch allows of hæmorrhage from both ends of the cut vessel. To arrest hæmorrhage from the palm, when no foreign body is in the wound, digital compression should be at once applied (Fig. 60). This is done (1) by applying the thumb, and preferably the left thumb, as thereby the right hand is left free for subsequent work. (2) Immediately the hæmorrhage is arrested, and without removing the thumb, fold a clean handkerchief with the free hand into a pad; apply this to the wound, maintain the pad in position by the thumb until another handkerchief or bandage is obtained and folded. With the pad in position, bend the patient's fingers on the pad and make the patient, if he can, grasp it firmly (Fig. 61). The helper with one or both hands thus free applies the bandage tightly over the clenched hand, so that the pad is firmly pressed

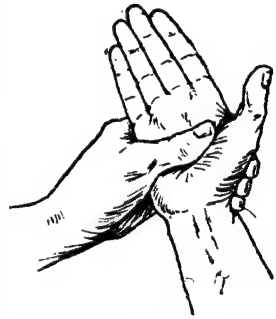


Fig. 60.—Digital compression for bleeding from the palm.

upon the wound. To apply the bandage to the hand, proceed as follows: First fold it into a narrow-fold bandage, and place the centre of the bandage over the knuckles of the clenched fist; bring the ends of it respectively over the front and back of the patient's hand, cross the ends below the projection of the thumb close down to the wrist; then carry the bandage round and round the hand (not the wrist) so

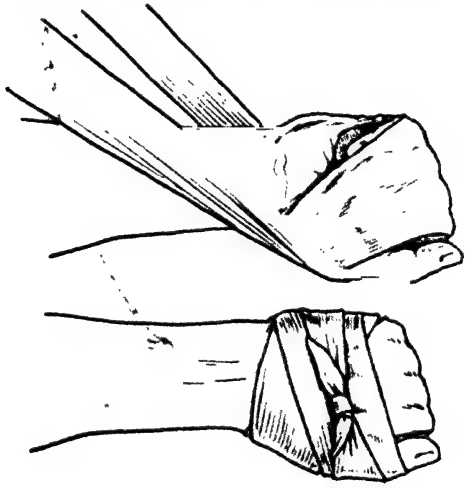


Fig. 61.—**Bandaging for wound in palm.**

as to press the fingers and thumb of the clenched hand as firmly as possible on the pad, tying the ends of the bandage firmly in a reef knot. Another, but less satisfactory plan is as follows: While the thumb is being firmly pressed upon the pad over the wound in the palm, lay a triangular bandage open, with the point away from the patient, on a flat surface. Lay the injured hand in the centre of the bandage, back of the hand downwards, bring the point of the bandage over the front of the clenched hand, so that the point now

lies just above the wrist, gather the ends together, carry them round and round the hand and wrist, and tie them off. The point (apex) of the bandage on the front of the wrist is now grasped and pulled tightly upwards towards the forearm, then turned down over the hand and pinned off. After arresting the hæmorrhage, raise the hand to the opposite shoulder and support it by a bandage.

Should a foreign body, such as a piece of glass, be found in a wound in the palm, the hæmorrhage must be

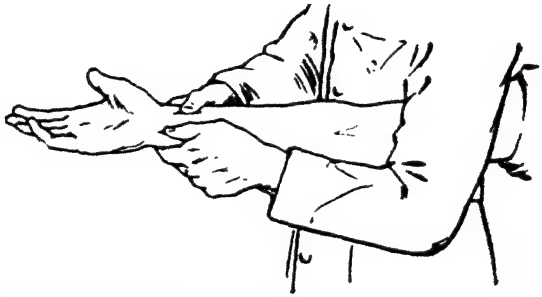


Fig. 62.—Digital compression of radial and ulnar arteries.

stopped by pressure upon the radial and ulnar arteries just above the wrist, or perhaps at the brachial.

A *graduated compress* is the most satisfactory means of obtaining pressure on any given point for wounds of the palm or elsewhere. Pads of lint of different sizes are superimposed one on the other, the smallest being next the wound, and the largest on the surface, so as to form a cone. Over all a bandage is firmly applied, so that the apex of the cone is pressed down on the bottom of the wound and the bleeding-point.

The Forearm.—The radial and ulnar arteries may be compressed above the wrist by the thumbs in the case of hæmorrhage from the palm of the hand (Fig. 62). Proceed as follows (taking the right upper limb as an example): When the palm is wounded, and it is desired to arrest the hæmorrhage by compressing the radial

and ulnar arteries just above the wrist, (*a*) bring the patient's right arm from the side of his body to a right angle with the trunk; (*b*) stand behind the arm thus raised; (*c*) pass the left arm over the patient's right arm, grasping it firmly to his (the helper's) side; (*d*) place the thumbs, the left over the ulnar artery, the right over the radial, 1 in. above the wrist (the thumbs are now about 1 in. apart); (*e*) press sufficiently firmly to arrest the hæmorrhage and no more. Should the helper be single-handed it will be found that by hugging the patient's arm very firmly to the side in the position above described, it is possible to arrest the flow in the brachial, and thereby set both of the helper's hands free to apply a pad and bandage, or perform other duties.

Hæmorrhage from wounds in the left palm is arrested in a similar fashion, the helper passing his right arm over the patient's left, and pressing it to his side. The great advantage of securing the patient's arm beneath the helper's is that the patient cannot drag his hand away should the doctor want to remove a foreign body from the wound, or apply a dressing, etc.

The radial and ulnar arteries may also be compressed above the wrist by applying the rounded side of a cork cut in halves; one half of the cork is placed over the radial, the other over the ulnar, their centres being 1 in. above the wrist, and 1 in. apart; the pieces of cork are held in place and secured by a bandage tied tightly round the limb so as to embrace the pieces of cork and the forearm; the wound in the palm will then require only a simple dressing to be applied. After the hæmorrhage is arrested the wounded hand should be raised and laid against the opposite shoulder, and secured by a bandage tied round the trunk and the wounded limb.

Should one or both arteries in the forearm be cut, the hæmorrhage may be arrested temporarily by applying digital compression on the wound, or by arresting the brachial in the front of the bend of the elbow, or in the middle of the arm.

At the Elbow.—The brachial artery as it lies in front of the bend of the elbow may be compressed by a

pad, bandage and flexion (Fig. 63). (*a*) Make a pad of a folded handkerchief, (*b*) apply the rounded side to the middle of the bend in front, (*c*) flex the forearm firmly upon the arm, and (*d*) maintain it there by a narrow-fold bandage or belt passed round the forearm close to the wrist, cross the ends between the forearm and arm, carry them round the upper part of the arm close to the shoulder, bring the ends forward, again crossing between the arm and forearm, and tie them off just above the wrist. Instead of a folded handkerchief for a pad, a roller bandage an inch in thickness may be used, or the *folded coat sleeve* as follows: Pull the sleeve of the coat upwards to half-way up the forearm, then roll it over and over until opposite the tip of the elbow behind and the bend of the elbow in front; the elbow is then flexed and secured as above.

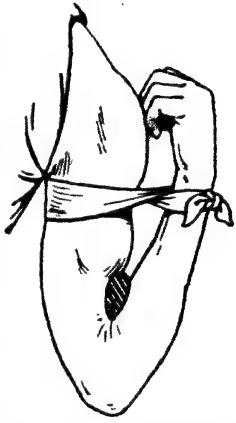


Fig. 63. — Application of pad to the brachial artery.

The Arm. — The brachial artery as it runs on the inner side of the biceps muscle may be compressed by the fingers or by a tourniquet. *Digital compression*, taking the right brachial as an example, is applied as follows (Fig. 64): (1) Raise the limb from the side to a right angle with the trunk; (2) turn the palm of the hand upwards; (3) stand behind the limb thus raised; (4) grasp the middle of the arm with the left hand, passing the fingers over the *front* of the arm to the inner side of the biceps (with the thumb behind) and well over the line of the brachial artery (Fig. 64, A); then, squeezing firmly (but not digging the tips of the fingers and the nails into the skin), rotate the hand outwards and backwards (Fig. 64, B). The artery in the arm may also be compressed by passing the fingers *behind* the arm. The fingers are passed forward well over the

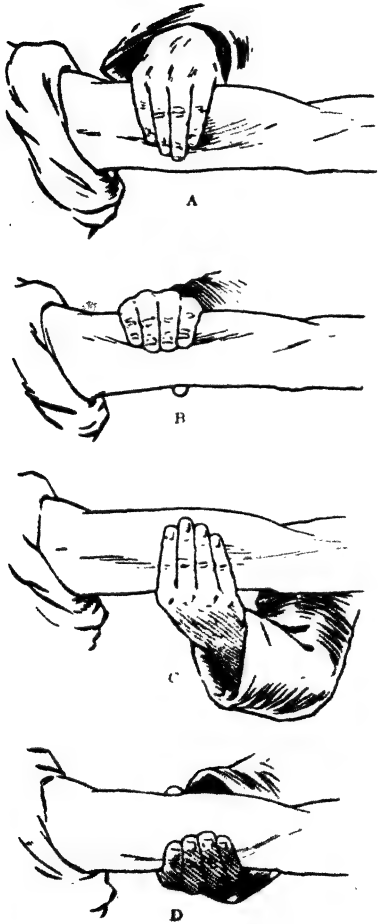


Fig. 64.—Digital compression of the brachial artery (*see* text).

line of the artery (Fig. 64, c), and, grasping firmly, rotate the hand inwards and forwards (Fig. 64, D). The rotation of the hand in these positions renders the compression of the artery more easy and certain.

A *tourniquet* may be applied to the brachial artery as follows: (*a*) A pad made of a cork wrapped up in a handkerchief, or of a roller bandage 1 in. in thickness, is to be applied lengthwise upon the artery; (*b*) a narrow-fold bandage encircles the limb by applying the centre of the bandage on the outer side of the limb, carrying the ends forward, crossing them over the pad, and tying off on the outer side of the limb; (*c*) between the halves of the knot a pencil, penholder, a large key, or any piece of stick is passed and twisted sufficiently

tight to arrest the hæmorrhage (Fig. 65). The ends of the twisting apparatus, be it pencil, key, or the like, are secured either by using the spare ends of

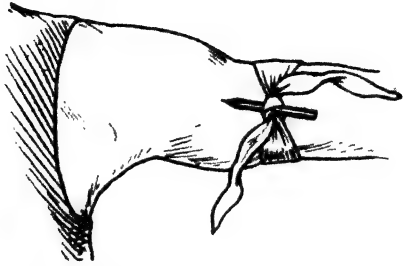


Fig. 65.—Tourniquet for the brachial (back view).

the bandage after the knot is tied, or by other bandages to tie the ends of the stick both above and below the tourniquet; or, again, one end of the twisting apparatus may be pushed underneath the second turn of the bandage used to secure the tourniquet (Fig. 66).

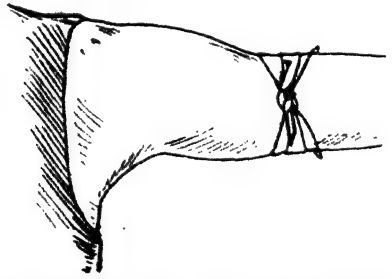


Fig. 66.—Tourniquet with end of twisting apparatus secured.

The Armpit.—The axillary artery may be compressed by a pad the size of a Bath bun pushed firmly up into the armpit, and held in place by a narrow-fold bandage (Fig. 67). Supposing it is the left axillary that

is in question, proceed as follows: Push the pad well up into the left axilla (armpit). Apply the centre of the bandage over the pad; carry the ends, one in front and the other behind, to the top of the left shoulder, where they are crossed, then carry the ends one behind and the other in front of the chest, and tie them beneath the right armpit towards the anterior (front) border. It is well to place a piece of cotton-wool or other soft material in the

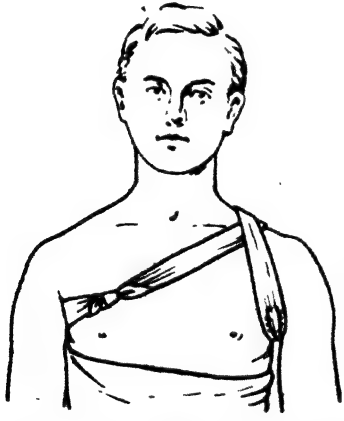


Fig. 67.—Pad applied to the left axillary artery (first stage).

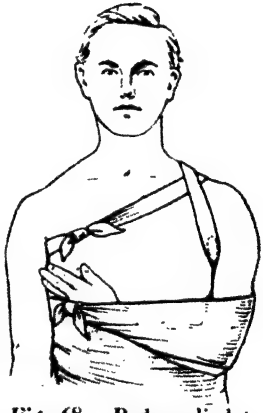


Fig. 68.—Pad applied to the left axillary artery (second stage).

right armpit to prevent the bandage from hurting. The left arm is now brought firmly to the side of the trunk, the hand raised as high as the opposite breast, and held in position by a broad-fold bandage carried round the trunk and the limb just above the elbow (Fig. 68).

The Subclavian.—To arrest the flow of blood through the subclavian artery, say on the left side, proceed as follows: Standing on the patient's left front, pass the fingers of the right hand backwards round the side of the lower part of the neck and lay the thumb in the hollow immediately above and behind the centre of

the left collar-bone. By pressing the thumb downwards and slightly backwards the artery is then compressed against the first rib (Fig. 69).

The subclavian may also be compressed by the handle of a large key wrapped in a handkerchief and pushed downwards against the first rib immediately above and behind the centre of the collar-bone.

Fig. 69.—Digital compression of the subclavian artery.

Arrest of Hæmorrhage from the Lower Extremities

Hæmorrhage from the **plantar** arteries of the sole of the foot or of the **dorsal** artery of the back of the foot may be arrested (*a*) by digital compression, (*b*) by a pad and bandage on the bleeding-point; or (*c*) by pressure upon the arteries at the ankle or the knee. Should no foreign body, such as a piece of glass, be present in the wound, pressure by the thumb (or thumbs) may suffice. The thumb may in turn be replaced by a suitable-sized pad and bandage applied over the wound. Should, however, any foreign substance be present in the wound, or should the above methods prove insufficient, the arteries at the ankle or the popliteal at the knee may be compressed. The arteries at the ankle lie one in front of the middle of the ankle (anterior tibial), the other on the inner side of the ankle (posterior tibial) half-way between the tip of the heel and the inner bony projection at the ankle-joint (inner malleolus). The two arteries in these positions may be compressed by placing on them corks or halves of a cork (Fig. 70) cut lengthwise, or firm pads, one

on the centre of the limb just above the ankle in front, and the other in the hollow on the inner side of the ankle. The corks are secured by a narrow-fold bandage carried over the pads around the ankle and over the tip of the heel. This form of arresting hæmorrhage from the foot is not satisfactory, as it is very difficult to keep the pads in place, so it is better to stop the artery at the knee.

The **popliteal artery** may be compressed by a pad of the shape and size of a golf ball placed at the hollow at the back of the knee—the popliteal (ham) space. The leg is then flexed until the heel approximates the

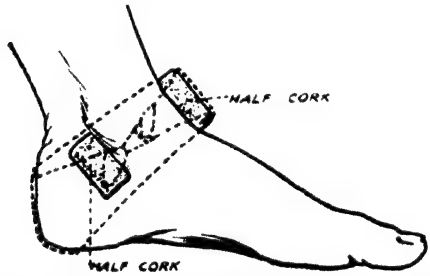


Fig. 70.—Compression of the arteries of the ankle.

hip; and a triangular bandage (narrow-fold) is applied as follows: Place the centre of the bandage on the front of the leg immediately above the ankle, cross the ends behind the leg and carry them round the thigh close to the hip and groin and tie them off. Instead of a pad the trouser leg may be pulled upwards until the foot of the trouser is half-way up the calf, the trouser is then rolled upwards until it reaches the centre of the knee-cap in front and the bend of the knee behind; the leg is then flexed and secured as above described (Fig. 71).

Femoral Artery.—*In the centre of the thigh* the trunk of the femoral may be compressed by a tourniquet. A line drawn from the centre of the groin to the back part of the inner side of the knee marks in

the upper two-thirds of its length the course of the femoral artery. Proceed as follows: A pad made of a cork wrapped up in a handkerchief, or of a roller bandage in thickness about 1½ in. and applied lengthwise, is placed over the course of the artery in the middle of the thigh. A narrow-fold bandage with its centre on the pad is carried round the thigh and knotted upon the outer side of the limb; between the halves of the knot a ruler, a walking-stick, an umbrella

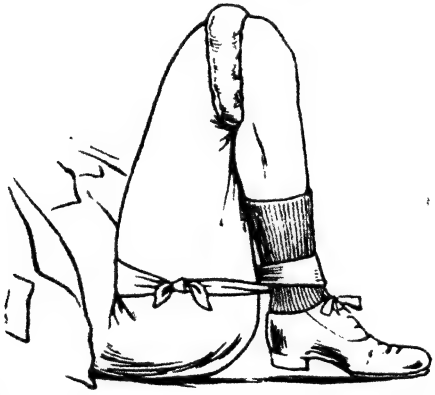


Fig. 71.—Compression of the popliteal artery.

(rolled up), the sheath of a sword, or a poker is inserted and then twisted; this proceeding will arrest the course of blood in the artery and stop hæmorrhage from any point of the limb below. The ends of the twisting apparatus are held in place by a bandage above and below the tourniquet (Fig. 72). The precautions given at p. 86 as to the use of a tourniquet are to be carefully observed.

At the groin digital compression may be applied to the femoral artery, where it lies in the centre of the groin, close below the skin, having a stout piece of the pelvis (haunch-bone) behind it. To compress, say, the right femoral artery at the groin by the thumbs,

proceed as follows: Lay the patient quite flat with the head on a low pillow; kneel on the left side of the patient's body, that is, on the side opposite to that on which the artery is to be compressed; pass the fingers of the right hand over the outer side of the right hip immediately below the bony ridge (crest) of the haunch-bone, and lay the right thumb flat upon the centre of the groin; pass the fingers of the left hand along the inner aspect of the right thigh close to the fork, and lay the left thumb upon the right already in position on the artery. Both thumbs are now pressed

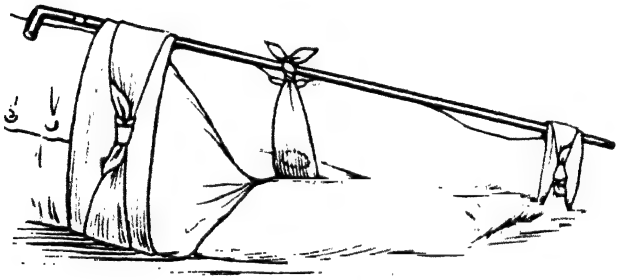


Fig. 72.—Improvised tourniquet applied to the femoral artery. The body is turned to show application.

directly backwards, when the flow of blood in the artery will be arrested by compression against the edges of the pelvis (Fig. 73).

Arrest of Hæmorrhage from the Head and Neck

The **carotid artery** (Fig. 74) as it passes up the neck on either side of the windpipe may be compressed against the front of the vertebral column. Suppose compression is to be applied to the left carotid artery (Fig. 75): Stand in front of the patient; pass the fingers of the right hand round the centre of the left side of the neck; lay the thumb in the hollow on the left side of the windpipe just on the outer side of the prominence formed by "Adam's apple" (the larynx), and press the thumb directly backwards against the back-

bone. When the right carotid has to be dealt with, use the left hand to compress the vessel.

Facial Artery.—Severe arterial hæmorrhage from the face anywhere below the level of the eye may be arrested by applying the thumb on the facial artery (Fig. 74) as it crosses the lower jaw a thumb's breadth in front of the angle of the jaw (Fig. 76). Hæmorrhage from the *cheek* may also be arrested by passing the forefinger into the mouth to the inner aspect of the cheek, with the thumb on the outside, and grasping the

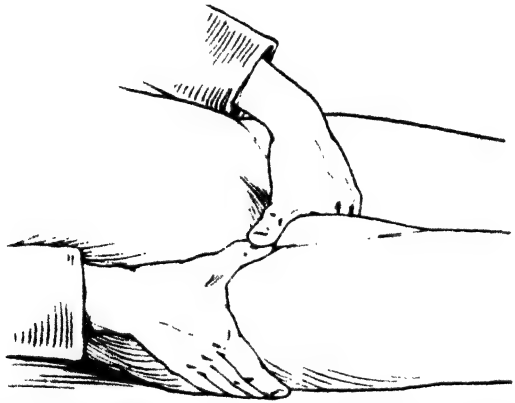


Fig. 73.—Digital compression of the right femoral artery.

cheek firmly below the level of the wound, that is, between the wound and the heart. Owing to the fact that the arteries in the lips form arches (oral arches) to which both facial arteries contribute, it may be necessary when the lips are deeply cut to compress both facials as they cross the lower jaw one on either side, or to compress the lips on either side of the wound between the forefinger and thumb of both hands.

Temporal Arteries. — The main trunk of the temporal artery is continued from the external carotid artery upwards in front of the ear to the

scalp. On a level with the highest point of the ear the artery divides into two—an anterior and posterior branch (Fig. 74).

Severe hæmorrhage from the temple (side of the head) may be arrested—(1) by digital compression

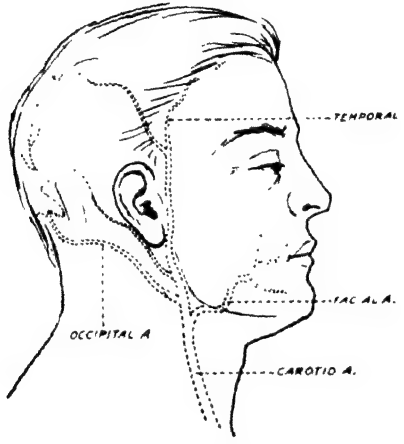


Fig. 74.—Arteries of the head.

directly on the wound. (2) By compression of the trunk of the temporal artery by applying the thumb immediately in front of the lappet (tragus) that guards the entrance to the ear passage, and pressing firmly against the bone (the zygoma, a process of the temporal bone) (Fig. 15). (3) By a pad and bandage on the wound. The pad, about the size of an ordinary watch, may be made of a handkerchief properly folded; the pad is applied with its rounded or smooth side directly upon the bleeding-point, and the pressure upon it maintained by a narrow-fold bandage.

There are several variations in the method of applying the bandage in this case. (1) After placing the pad on the wound, lay the centre of the bandage

on the temple of the *sound* side; carry the bandage round the head just above the eyebrows in front and over the prominence of the head behind; bring the ends over the pad, crossing and twisting them once, twice, or oftener on the pad. The ends of the bandage may now be carried in one of two ways round the head: (*a*) (Fig. 77) vertically, one end being passed over the top of the head, the other below the chin, and tied off on the temple of the sound side; or (*b*) horizontally, the ends of the bandage, after being twisted over the pad, being

Fig. 75.—Digital compression of the left carotid artery.

Fig. 76.—Digital compression of the facial artery.

carried round the head, and tied on the temple of the sound side, as in Fig. 79 for the forehead. (2) After applying the pad on the wound, commence the application of the bandage on the *wounded* side, placing the centre of the bandage on the pad, carrying the ends round the front and back of the head to the opposite temple, where they are crossed and carried round the head and tied off directly over the pad (Fig. 78).

The Forehead.—To arrest severe arterial hæmorrhage from the forehead, apply digital compression (the thumb) directly on the wound; replace the thumb by a pad and bandage. Commence the bandage over the back of the head, bring the ends horizontally round

the head, cross and twist the bandage on the pad, and carry the ends round the head again, and tie behind. In this case also, as for the temple, the bandage may be commenced directly over the pad (Fig. 79).

Back of the Head.—The *occipital artery*, one on either side, is the principal blood-vessel at the back of the head. The artery is continued upwards from the external carotid in the neck, and reaches the scalp four fingers' breadth behind the back part of the rim of the ear (Fig. 74). Thence it spreads out into branches

Fig. 77.—Bandage applied to the temporal artery.

Fig. 78.—Bandage applied to the temporal artery.

for the back of the head and scalp. To arrest hæmorrhage from the back of the head: (*a*) The trunk of the occipital artery may be compressed by placing the thumb where the neck and head join, at a point four fingers' breadth behind the rim of the ear. It may be necessary to compress both arteries at the same time. (*b*) Digital compression (the thumb) may be applied directly on the wound. (*c*) A pad and bandage may replace the thumb. The bandage may be commenced on the opposite side from the wound, the ends twisted over the pad, brought round the head again and tied; or the centre of the bandage may be placed on the pad, brought round the head, crossed on the forehead, the

ends carried to the back of the head again, and the knot tied on the pad (Fig. 80).

Top of the Head.—Hæmorrhage from a wound of the scalp is arrested by—(*a*) digital pressure on the wound; (*b*) a pad on the wound secured by a bandage, either commenced on the pad, carried round below the chin and the ends tied off on the pad on the top of the head, or commenced below the chin, the ends twisted on the pad and tied off beneath the chin (Fig. 81).

A Ring-Pad.—In wounds of the scalp, if very extensive,

Fig. 79.—Bandage applied to the forehead.

Fig. 80.—Bandage applied to the back of the head.

or when associated with a fracture of the bone immediately beneath, the arrest of hæmorrhage becomes a difficult matter. If a pad is placed on the wound when a piece of the subjacent bone is broken off, the pad and bandage, when tightly applied, would press the piece of bone into the brain. To avoid this the following expedient is useful (Fig. 82): Take a triangular (or other) bandage, fold it four times until it is quite a narrow cord, grasp one end in the left hand, and with the right carry the bandage round and round the left hand to form a ring. When within 2 ft. of the free end of the bandage, leave off twisting it round the hand, and instead twine the end round the ring thus made.

Apply the ring on the scalp so as to have the wound and the depressed piece of the bone in the centre. A folded triangular bandage with its centre applied on the ring, and the ends carried round and round the head, or horizontally or vertically (below the chin) according to the situation of the wound, will help to arrest the flow of blood leading to the wound without unduly pressing on the broken bone.

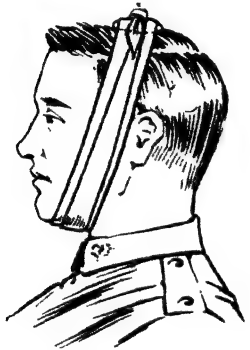


Fig. 81.—Bandage applied to the top of the head.

Fig. 82.—Ring-pad.

Internal or Concealed Hæmorrhage

When blood escapes within one of the large cavities of the body—the abdomen or the chest—it is termed internal or concealed hæmorrhage. The signs and symptoms of severe internal hæmorrhage are similar to those arising in cases of external hæmorrhage when a large artery is wounded (p. 82).

In the Chest.—When blood escapes into either of the large cavities (pleuræ) around the lungs, it may flow to such an extent as to cause severe symptoms, or even, and not infrequently, death. When a rib is broken one of the arteries (intercostal) accompanying each rib may be torn and bleed, or the rib may penetrate the lung, when severe hæmorrhage will follow. In

the former instance the symptoms will develop slowly; in the latter, if the wound in the lung is large, very speedily. A stab, bullet, bayonet, or other wound of the chest may likewise cause the lung to bleed. When the standing position is assumed the blood accumulates at the lowest part of the cavity of the pleura; when the patient is lying down the blood will flow to the back or to one side of the cavity according as he lies on the back or the side.

Treatment.—Lay the patient down in the horizontal position with the head low; undo all tight clothing that is likely to hamper breathing; if indoors provide for ample ventilation by opening doors and windows, fanning, etc.; incline the patient's body towards the injured side, as in this position the blood is prevented from accumulating at the lower part of the chest, but instead it accumulates around the seat of the wound and by its coagulation helps to check the flow from the cut or torn vessels. When signs and symptoms of severe loss of blood supervene, bandaging the extremities with roller bandages from the toes to the groin, and from the fingers to the shoulder, will help to remove faintness by driving to the heart and brain an increased quantity of blood; ice, or sips of iced water, will mitigate the thirst, but no stimulants must be given. An ice-bag placed over the seat of injury on the chest will also do good.

In the Abdomen.—A blow, a bullet, or a stab may occasion severe hæmorrhage within the abdomen by wounding one of the large blood-vessels, or important organs such as the stomach, the liver, the spleen, or the kidney. The blood may come from a large vein or from an artery, but in either case the conditions are practically the same.

Treatment.—Lay the patient down on the back; apply a pad of cotton-wool 6 in. thick over the abdomen and wrap the body round with a broad roller bandage or a large bath-towel pulled firmly and fastened by safety pins. Instead of wool, several layers of flannel or of a folded bath-towel may be used to make a pad. Ice may be given to suck, except when the stomach is considered to be the seat of injury. The lower limbs and the upper limbs should be raised

and bandaged as for internal hæmorrhage generally (p. 82).

On the Brain.—Hæmorrhage may also occur within the cranium (*see* Apoplexy, p. 137), or into a joint (*see* Sprain, p. 58), or below the skin (*see* Bruises, p. 112)

VENOUS HÆMORRHAGE

When a large vein is cut across, the blood that issues has the following characteristics: (1) It is of dark-blue colour. (2) It issues from the end farther from the heart (the distal end). (3) It flows in a steady, oozing stream, not in jets as in the case of an artery.

If the **lower limb** is the seat of the hæmorrhage, lay the patient down and raise the foot. If the wound is in the **upper limb,** seat the patient in a chair or on the ground, and raise the hands above the head. In either case bare the part so as to see the bleeding-point, and (*a*) apply the thumb to the bleeding-point, (*b*) replacing it as soon as possible by a pad and bandage. Should blood, after a time, begin to ooze from beneath the pad, do not remove the pad, but carry a narrow-fold bandage round the limb on the side of the wound farther (distal) from the heart, and secure firmly.

Varicose Veins.—In the lower limbs especially, the surface (superficial) veins are apt to become dilated. This condition is brought about by long standing whilst at work, by the wearing of a garter below the knee, by weak circulation, and various other causes. When commencing to dilate, owing to the blood accumulating behind the valves (*see* p. 73) within the veins, the outline of the vessel presents a beaded (varicose) appearance. In course of time the vein may distend to an enormous size, and is seen as a tortuous vessel as thick as a finger, causing even the skin over it to be raised. Should a varicose vein in the leg be wounded, the blood escapes in very large quantity; this is due to the fact that the blood not only escapes from the end of the vein farther from the heart, as in an ordinary case of venous hæmorrhage, but also flows from the end of the vein nearer the heart, owing to the valves within the veins being rendered useless on account of

he increased width of the vein preventing them from neeting.

Treatment.—When hæmorrhage from a large varicose ein occurs in the leg, (1) lay the patient down; (2) aise the limb; (3) bare the wound; (4) apply digital compression by the thumb; (5) replace the thumb with a pad and bandage, and (6) during removal keep the imb still raised. Should blood, after a time, begin o ooze from beneath the pad, do not remove the pad, ut, instead, carry narrow-fold bandages round the imb, one above and another below the wound, and secure tightly (Fig. 83); this proceeding is necessary, as blood from a wounded varicose vein issues from oth ends of the cut vessel, as explained above.

Hæmorrhage from the Neck.—When a vein (usually the jugular) is cut, it is impossible to do more than apply digital compression until the doctor arrives. The thumb may be applied on the bleeding-point, or if this is not possible, the thumb is to be applied on the trunk of the vein leading to the wound, that is, on the side farther from the heart, which in the case of the neck is the *upper* margin of the wound.

Hæmorrhage from the Nose.—When the nose bleeds to any great extent, arrest the flow of blood as follows: (*a*) Seat the patient in a chair with the head slightly thrown back; (*b*) raise the hands above the head, clasping them to secure fixity; (*c*) undo all tight clothing round the neck and chest; (*d*) apply a sponge wrung out of cold water, a piece of ice, or a piece of metal (a bunch of keys because they are cold) to the back of the neck over the prominent vertebra, that is, where the neck and the back join. Some pounded ice in a handkerchief or sponge bag laid across the bridge of the nose will help to arrest the flow. See that a current of fresh air is allowed to circulate round the patient. Should the hæmorrhage persist a doctor must be called in to plug the nostrils.

Hæmorrhage from the Tongue.—A piece of ice allowed to melt in the mouth will serve to check even smart hæmorrhage from the tongue; when the hæmorrhage is severe the wound in the tongue, if within reach, must be grasped between the finger and the thumb and

held firmly for several minutes, the pressure being re-applied if the bleeding continues or recurs. When it is impossible to grasp the wound in the tongue it may be necessary to compress the carotid artery on one or both sides of the neck.

Hæmorrhage from the Lung (hæmoptysis or spitting of blood).—Blood may be coughed up as the result of injury or disease of the lung; the colour of the blood is bright red; and, unless in very large quantity, it presents a frothy appearance owing to admixture with air. The bleeding may be caused by a broken rib (*see* p. 107).

Treatment.—(*a*) Place the patient in a reclining posi-

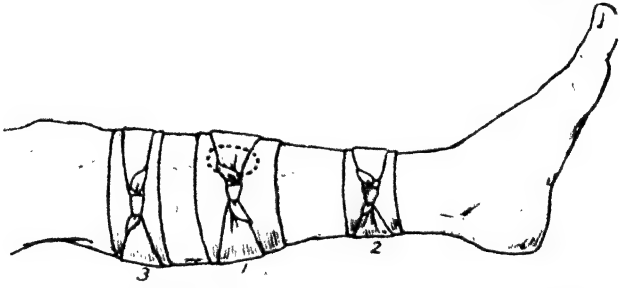


Fig. 83.—Bandages for burst varicose vein in the leg.

tion, with the head and trunk raised; (*b*) undo all tight clothing; (*c*) provide for a free circulation of air; (*d*) give ice to suck; and if it is known from which side of the chest the blood is coming (*e*) incline the patient towards the affected side, and (*f*) apply ice freely to the surface of the chest.

Vomiting of Blood (hæmatemesis).—Blood may be vomited as the result of either injury or disease of the stomach; the vomited blood is of a dark colour, and, unless in very large quantity, is in small clots, giving the vomited matter a coffee-grounds appearance.

Treatment.—(*a*) Lay the patient down in a reclining position, but with the head and trunk well raised; (*b*) undo the clothing over the chest and abdomen; (*c*) allow of a

free circulation of air; (*d*) apply an ice bag over the pit of the stomach. Do not give anything (ice, water or food) by the mouth when there is hæmorrhage from the stomach.

Hæmorrhage from the Kidney.—As the result of a blow over the seat of the kidney in either loin, or from disease, blood may be passed in the urine.

Treatment.—According as the seat of the injury is over the right or left kidney, place an ice-bag on the right or left loin behind. Ice may be given to suck, but not deep draughts of water.

Should the **bladder** be injured, apply cold or heat over the front of the lower part of the abdomen, according as the patient requests.

Fig. 83A.—Screw Tourniquet (p. 88).

CHAPTER VII

BRUISES, WOUNDS, BITES AND STINGS

Bruises

A blow of some severity on the skin causes injury to the blood-vessels in and beneath the skin at the part struck. The capillaries are ruptured, and blood escapes to a greater or less degree according to the extent of the injury. At first the skin is reddish in appearance, but the colour speedily deepens to a violet or dark-purple colour, which, after persisting for some time, assumes a lighter tint, and the colour fades away into a greenish-yellow hue before assuming a normal appearance. Owing to the effusion of blood, the bruised part may be raised above the level of the surrounding skin.

Effusion of blood may also appear below the skin when there is damage of the organs and tissues, independently of a blow on the skin. When a joint is sprained, a muscle torn, or a bone broken, blood is effused, and shortly after the accident blood will show itself below the skin, and cause discoloration. The effusion may be widespread; thus in a case of sprained ankle the foot and the leg may be generally discoloured.

Treatment.—When a bruise is occasioned by a blow, ice, or ice-cold water, or cold water dressings with or without the addition of methylated spirit (a tablespoonful to a pint of water applied to the part) and allowed to evaporate—that is, not covered over—will help to lessen the amount of blood effused. Cold applications may be continued for some six or eight hours, when the part should (not on the face) be enveloped in a layer of cotton-wool 2 or 3 in. thick and bandaged; after a few days apply the bandage alone.

Wounds

Aseptic and Septic Wounds.—The wound made by a surgeon during operation is said to be aseptic or

clean when the patient's skin, the instruments, and the surgeon's hands have been "prepared," that is, rendered aseptic before the operation is begun. Septic (putrid) wounds are injuries in which infecting material (germs) gains access to the wound either at the time of the wound being made or subsequently.

Abrasions.—When the skin is injured so that the scarf skin is removed and the true skin exposed, the injury is termed an abrasion. A child falling on the knee, when running, may receive a "gravel rash," and may suffer at the moment some pain, which, however, soon passes off. The injury may seem insignificant at first, but if the child irritates the part by walking about and bending the knee, or if it is chafed by the clothing, inflammation may supervene and local or constitutional trouble be set up.

Treatment.—Wipe the surface clean with boiled water and a clean piece of lint or linen; cover with a dressing of lint, on which vaseline, olive oil, cold cream, or boric ointment is spread, and bandage the knee so as to prevent friction. If the part becomes irritated or inflamed it will be necessary to put on a splint to keep the knee stiff for a few days. Instead of a splint, tying the limb to a pillow may suffice for young children.

Incised Wounds.—A wound of the skin inflicted by a knife or other sharp instrument presents a clean-cut edge; the wound gapes; and hæmorrhage, varying in character and amount according to the depth of the wound and the part of the body cut, ensues.

Treatment.—If the accident occurs *out of doors*, arrest the hæmorrhage at once by applying a clean handkerchief, wrapping it round the part so as to exercise pressure. Should a clean handkerchief not be available place a piece of clean paper (not newspaper or paper written upon) next the cut and wrap a handkerchief firmly round. If the hand is cut *indoors* and the wound is small and the cutting instrument clean, such as a bread knife or razor, place the hand in water (hot or cold) until a clean piece of lint, linen, or cotton-wool is obtained; lay this on the wound and bandage firmly with a strip of linen, a piece of tape, or strapping plaster; keep the dressing on, if the part is comfortable,

for a few days until healing has occurred. If the wound is large, as when the forehead is cut by a piece of glass or by falling on the sharp edge of, say, a fender, arrest the hæmorrhage, which is often severe, not only from capillaries but also from small arteries, by a pad and bandage. Unless the edges of the wound (if large) are brought together, an ugly scar may result. In such a case the doctor must be called in to stitch up the wound, or, if no doctor is at hand, the pad and bandage must be removed and the edges brought together by a piece of strapping.

Plaster used for strapping may be either diachylon plaster (lead plaster), which requires to be heated before it will adhere to the skin, or Mead's readily adherent plaster, which sticks firmly without being heated. When being applied to bring the edges of a wound together, fix one end of the strapping on the sound skin some inches from the margin of the wound. Bring the edges of the wound together between the finger and thumb with the free hand, and whilst thus grasping the skin, pull the strapping across and fix it on the opposite side of the wound for an equal distance on the two sides. When removing the plaster from the wound, raise both edges at once and slowly and equally raise the strapping from the skin, so that there is no dragging of one side of the wound more than the other. Should any of the plaster material stick to the skin, this may be removed by dabbing turpentine upon it, rubbing olive oil over it, or wiping with a hot cloth or lint. The skin should be shaved if the plaster is to be applied on any hairy part. When the wound is dirty, or a piece of clothing, glass, porcelain, nail, etc. has been carried into the wound, remove the foreign body; it is most important to wash the part with boiled water to which a disinfectant is added, such as carbolic acid (1 in 40) or permanganate of potash crystals (added until the water is a deep purple). The wound should not be closed by strapping, but, instead, a wet dressing of lint or linen dipped in warm water, covered with oiled silk and a bandage lightly applied.

Contused Wounds.—A severe blow by a club, truncheon, or other blunt instrument may occasion not only

a bruising of the part, but also a tearing of the skin. The edges of the wound are jagged and depressed, and the wound does not gape; the hæmorrhage, as a rule, consists in a mere trickling of blood, but around the wound the parts will be raised owing to the effusion of blood beneath the skin.

Treatment.—Cleanse the wound, and cover it with a dry dressing, such as lint or cotton-wool, and bandage lightly.

Lacerated Wounds.—When the skin and the parts beneath are torn by machinery, by a cannon shot or shell, or mauled by an animal, the surface of the wound usually presents a ragged appearance. Even if a limb is torn off by machinery, by the wheel of a railway carriage, or by a shell, the hæmorrhage may be quite insignificant, for the blood-vessels are stretched before being severed, and their walls, owing to their ragged edges, tend to occlude the mouth of the severed vessels. The shock also, by weakening the circulation and the heart, lessens the chance of bleeding. In a lacerated wound the several tissues of the body will be seen to behave differently: the skin recedes, leaving exposed the muscles and tendons; the nerves hang loosely from the wound, and the bone ends protrude, presenting a jagged appearance.

Treatment.—Envelop the whole wound in clean linen or lint, cover with a thick layer of cotton-wool, and bandage the part firmly to arrest oozing of blood. Although a lacerated wound may not bleed much at the time of the accident or for some time after, hæmorrhage is apt to occur as the patient recovers from the shock, and it is well to anticipate this hæmorrhage by applying loosely round the limb above the wound a tourniquet which can be tightly twisted should bleeding appear.

Punctured Wounds.—A stab with a knife, bayonet, hat pin, or even a needle, is termed a punctured wound. The appearance of the wound varies with the kind and size of the weapon. It is always relatively small, and the edges are driven inwards. The hæmorrhage, unless a large blood-vessel is wounded, is insignificant, but the shock to the system may be severe.

Treatment.—Remove the weapon if left in the wound, arrest hæmorrhage if severe, and cover up the wound as soon as possible with a clean dressing or cotton-wool. *N.B.*—Do not probe the wound.

Gunshot Wounds.—If a patient is peppered by shot from a sporting gun, envelop the part in a towel wrung out of hot water, changing it from time to time; treat for shock in the usual way. Do not attempt to remove all the shot if a full charge is received, but only those easily reached. As a rule, the buried shot will cause no inconvenience subsequently.

Bullet Wounds.—A bullet may enter the skin and lodge in the tissues, or it may traverse the limb, body, or head, and find exit. There will thus be one or two apertures apparent. The aperture by which the bullet enters (the *aperture of entrance)* is relatively small, its edges are depressed, and hæmorrhage is uncommon. The *aperture of exit* is relatively larger, the edges of the wound are raised and everted, the hæmorrhage is seldom more than a few drops, unless a large vessel has been severed, when blood may issue from one or both wounds.

Treatment.—Without probing the wound, cover the part with a clean dressing or cotton-wool, and if it is one of the extremities that is wounded, apply splints to keep the joints above and below the injured part steady. Arrest hæmorrhage if present. The amount of shock and danger depends upon the part penetrated.

Improvised dressings for wounds may be made from any piece of linen, cotton, butter cloth, silk, fine muslin, etc., washed and boiled. In emergency clean notepaper, not printed paper or paper that has been written upon, may be used next a wound for First-Aid or temporary purposes; an envelope may be laid open, and the clean or inner (unwritten-upon) surface placed on the wound. If the paper is heated before the fire until lightly scorched it will be sufficiently sterile. Burnt paper laid next the wound will be still better. Ashes obtained by burning wood, clothing, or vegetable tissue are, when sufficiently cooled, a sterile dressing of value. The ashes from a burnt garden-rubbish heap are usually readily obtainable in any country district,

and if employed soon after cooling are quite safe substitutes for boric acid, iodoform, etc.

For further information on First Field Dressing, materials used in dressings, inflammation in wounds, sterilisation, etc., see the British Red Cross Society's Training Manual, No. 3.

Bites and Stings

Dog Bites.—Bites from dogs, in countries in which rabies prevails amongst animals, may cause hydrophobia in man. In Britain this danger has been reduced to a minimum, owing to the fact that rabies in the dog was stamped out by the Muzzling Act. A bite of a dog, however, must always be regarded as dangerous. The hand is the part most liable to be bitten, but any part of the body may be seized by a dog, and the skin and tissues severely torn.

Treatment.—When the finger is bitten proceed as follows: Completely encircle the finger above the wound (that is on the side nearer the heart) with the finger and thumb of the other hand, so as to stop the circulation in the veins of the finger, and thereby prevent absorption of any poison which may have been conveyed by the animal's teeth. Squeeze the finger downwards towards the wound so as to cause the blood to flow more freely; suck the wound if no running water is near, spitting out the blood. Allow a stream of water, hot by preference, to flow over the wound so as to encourage the flow of blood, and to wash the part clean. If a helper is at hand he should tie a piece of tape or strip of a handkerchief round the root of the finger tightly, so as to compress the veins; when this has been done, and not before, the finger and thumb encircling the bitten finger may be removed. As soon as possible apply a fluid caustic, such as potash, pure carbolic acid, nitric acid, or any of the strong acids, to the wound, sharpening a wooden match, or other piece of wood, and after dipping it in the caustic or acid, pushing it into the wound as far as possible. This done, remove the tight band round the root of the finger and dress the wound in the ordinary way. If the dog is known to be rabid, or suspected to be so, get

the patient treated by inoculation (Pasteur's treatment) as soon as possible. The bite of any animal, horse, cow, cat, rat, wolf, etc., should be treated in a similar fashion, because each and all of them may convey a poison of some sort to the system unless this is prevented by the steps above described. In a part covered by clothing the danger of infection is lessened, as the animal's teeth, by which the poison is conveyed, are cleansed as they pass through the clothing; but whether the bite is through the covered or the uncovered skin, steps should be taken to prevent the poison from gaining access to the system. If the bite is in any part of a limb except the finger, pass a handkerchief round the limb between the wound and the heart, and, after tying the knot, slip a piece of wood, a key, or the like, between the halves of the knot, and twist tightly, thus applying a tourniquet. The wound is then washed, cauterised, and dressed as above described. If the bite is on the face, neck, or trunk encourage bleeding, wash the wound freely, and when possible apply caustic.

Snake Bite.—The venom of a poisonous snake is conveyed from the poison bags in its head along ducts which open into the snake's fangs, and are conducted down through the fangs to their points. When the snake strikes and the fang has penetrated the skin, the poison is injected through the fang to beneath the skin, in the same way as fluid is injected from a hypodermic syringe. The poison, therefore, speedily enters the blood-vessels, and is apt to take immediate effect.

Treatment.—Do not wait for symptoms nor to ascertain whether the snake is poisonous, but immediately encircle the bitten finger with the finger and thumb of the other hand, suck the wound, wash it, and tie a tape round the root of the finger as directed above for a dog bite. The wound may be cauterised, but it is deemed more satisfactory to insert a strong solution or the actual crystals of permanganate of potash into the wound, or still better to have the solution injected into the tissues round the wound by a hypodermic syringe. At times in snake bite, and in punctures made by the teeth of other animals, the wound should be enlarged

by a small cut with a knife. If the foot or leg, the hand or forearm is bitten by a snake, place a tourniquet round the thigh or arm respectively (not the leg or forearm) at once, and treat the wound as above described. If it is impossible to apply a tourniquet, as when the trunk is bitten, apply permanganate of potash as speedily as possible.

Bee and Wasp Stings.—A sting from a bee may occasion severe symptoms, in some instances having a fatal ending. Following the pain of the sting, the person stung feels a slight chilliness all over the body, which is occasionally succeeded by a feeling of faintness, palpitation of the heart, pallor, vomiting, swelling of the face, hands and feet, and sometimes delirium, or unconsciousness. A wasp sting may induce similar consequences.

Treatment.—The part stung should be firmly squeezed between the finger and thumb to eject, if possible, the actual sting or the poisonous fluid conveyed by it. The pressure should be maintained for some minutes, and the part meanwhile wiped freely with spirits of wine, or whisky, brandy, or gin for some five or ten minutes. If nothing else is at hand the blue bag may be applied after the part has been well squeezed. A solution of permanganate of potash well rubbed into the part has also highly beneficial effects. The constitutional symptoms, when severe, must be treated by laying the patient down on a couch or bed, undressing and then covering him with a sheet or light blanket, applying a mustard plaster or mustard leaf over the pit of the stomach, and giving sips of brandy and water from a teaspoon from time to time. If symptoms continue, a doctor must be sent for at once.

Bites from Centipedes, Tarantulas, or other Venomous Insects.—These bites should be freely sponged with sprits of wine, whisky or brandy, and a solution of permanganate of potash rubbed into the wound or injected beneath the surrounding skin. If the bite is in a part of the body where a tourniquet can be applied, this should be done.

CHAPTER VIII

BURNS AND SCALDS, ELECTRIC SHOCK, FROSTBITE, CHILBLAINS, BLISTERS, ETC.

Burns.—A burn is caused by flames or heated metal, etc., coming in contact with the skin. A scald is due to injury of the skin caused by fluids such as water, oil, tar, etc., at high temperatures. A burn corresponds to roasting, a scald to boiling, of the tissues.

The extent of destruction caused by a burn varies in degree as follows: (1) A mere reddening of the skin; (2) the formation of a bleb or blister between the true skin and the scarf skin; (3) partial destruction of the true skin; (4) complete destruction of the skin; (5) charring of the soft tissues beneath the skin; (6) the complete charring of the limb. The danger to life in consequence of a burn (or scald) depends not so much upon the depth to which the burn penetrates, as upon the extent of the surface of the skin involved. Should one-third of the surface of the skin of the body be destroyed by extreme heat recovery can scarcely be expected. Death is usually due to shock, which is present in all cases of fairly severe burn or scald. Should the patient recover from the shock there are subsequent dangers to be contemplated, due to reaction, contraction of the scars, etc.

The *signs and symptoms* presented by burns and scalds are for the most part identical up to the third degree (destruction of the true skin), but a burn may cause charring of the tissues and the formation of black scabs from destruction of the skin, muscles, tendons, etc.

Treatment.—The principles to be followed in treating burns or scalds are: Treat shock, exclude the air from the burnt part, apply dressings to soothe the pain and prevent poisonous germs entering the wound. Suppos-

ing the upper limb, from the hand to the shoulder, is severely burnt, proceed as follows: (1) Remove the clothing from the injured limb; should any pieces of the clothing be incorporated with the charred tissues of the skin, do not remove them, but cut away the clothing around, leaving them to come off subsequently. Do not prick blisters, but (2) immediately proceed to cover up the limb so as to protect the burned surface from the air. This is accomplished by applying oily substances, by flour or dusting powders, or by plunging the limb into warm water. (*a*) Wherever possible the limb should be immersed in *warm water*, that is, in water of the temperature of the body, about 98° Fahr., or if need be the patient may be unclothed and laid in a warm bath. When the trunk of the body is burnt the patient should be immersed as soon as possible in a bath of warm water at the temperature of the body, and the warmth kept up by adding warm water from time to time. (*b*) Less satisfactory but frequently imperative to use, owing to warm water not being obtainable, are *oily substances*. The oily substances which may be used are olive oil, linseed oil, carron oil (equal parts of either linseed oil or olive oil and lime water), cod-liver oil, vaseline, lanoline, cream, lard, beef or mutton dripping, and such ointments as simple ointment, boric ointment, cold cream, hazeline snow or cream, etc. To apply an oily substance take a number of strips of lint or linen long enough to encircle the limb and some 6 in. wide; soak the pieces of lint in the oil, or spread the ointment upon the strips of lint, and apply them to the limb from the hand to the shoulder; cover the dressing with a thick layer of cotton wool and bandage lightly from the fingers to the shoulder; lay the limb in the most comfortable position available. The object of applying strips of lint instead of one large piece is that when the burn has to be dressed, the whole extent of the burned surface is not exposed to the air, but, as one small strip is removed so a fresh strip is applied, allowing thereby of only a small part of the surface being exposed at one time. (*c*) When no oil is available dust the surface of the burnt limb with a thick layer of *flour*,

ground starch, corn flour, arrowroot, powdered boric acid, etc. The starch or flour may be made into a paste with warm water, the limb may then be covered with cotton-wool and a bandage, as in the case of applying oils. (3) In all cases of severe burn a most important point to attend to is the treatment of shock; this is done by applying warmth without and giving hot fluids to drink, as described under Shock (p. 141).

Scalds.—Supposing a foot and part of the leg to be scalded by boiling water, proceed as follows: (1) Remove the boot, cutting the lace and leather if need be, and take off the sock, cutting it from top to toe, and taking care not to prick the blisters with the point of the scissors or the knife. (2) When the foot is bared place it in warm water, or if this cannot be had cover the part immediately with oily substances, or with flour, etc., as in the case of a burn. The addition of bicarbonate of soda to warm water tends to relieve pain; the proportion should be—to a basinful, a heaped dessertspoonful; to a bucketful, a heaped tablespoonful; for a bath, a couple of handfuls. Lint dipped in warm water, to which bicarbonate of soda has been added, is a grateful application in all cases of burns, however slight. (3) Shock has also to be treated (p. 141).

Clothes catching Fire.—Should the *front* of a woman's dress catch fire, (1) lay her down at once, forcibly, tripping her up if need be; (2) place her on the back so that the flames are uppermost, as in this position they ascend away from the body, and are thus prevented from reaching other parts of the dress, whilst the lower extremities are less exposed to the chance of being burnt. Whichever part of the clothing is burning, always lay the patient down so that the flames are uppermost. (3) The flames should then be extinguished by wrapping the burning clothing in a coat, blanket, table-cloth, carpet, or rug, tightly, so that the flames are smothered; or if water is handy it may be thrown upon the burning clothing. The subsequent treatment of the patient is the same as for burns and scalds.

Should **corrosive fluids**, such as acids (nitric, hydrochloric, sulphuric, carbolic, etc.) or alkalis (caustic potash, soda, etc.) burn the skin, the part

should be soaked in warm water, continually changing the water so as to wash away any excess of the corrosive fluid that may be present. If the corrosive is known to be an acid, add bicarbonate of soda or Epsom salts, fluid magnesia, lime water, or well diluted liquid ammonia to the water; if the corrosive is known to be an alkali, pour a small quantity of vinegar into the water. Get ready a dressing of oily substances or ointments, as in the case of an ordinary burn.

Burns in the Face.—If the face is burnt by flames, or by an acid or alkali dashed in the face, douche the face with warm water until a mask is prepared. To make a mask, take a double layer of lint or linen of sufficient size, when doubled, to cover the face; between the two layers place cotton wool 2 in. deep, and stitch together the edges of the mask thus formed with needle and thread; cut holes in the mask for the eyes, nose, and the mouth; smear the mask on one side with vaseline, or lanoline, or other applications (*see* p. 121) if those are not handy, and lay it on the face. Secure the mask in position by sewing strips of bandage or tape to the edges of the lint, and tying the ends round the head. Should the eye-balls be involved, drop a little castor-oil on to the surface of the eye, closing the lids over it, and smear the outer surfaces of the lids with vaseline, lanoline, or hazeline cream, etc. The lips and nostrils, if burnt, may be smeared with glycerine or fresh butter.

Scalds of the Throat.—When by the accidental drinking of boiling water (or of fluid caustics) the throat is scalded, there is a danger of the inlet to the air-passage at the opening in the larynx becoming so obstructed that the breathing is interfered with. The accident most frequently occurs in children who inadvertently swallow water from the mouth of a kettle or teapot whilst on or just taken off the hob.

Treatment.—Apply a sponge or flannel wrung out of hot water from the chin to the lower part of the front of the neck, covering the front and sides of the neck well; give the child sips of cold water or pieces of ice to suck; keep him in a warm room, and free from currents of cold air.

Electric Shock.—The dangers connected with handling electric apparatus, or touching electric wires, cables or rails, are known to the public in a general way. The consequences depend on the strength of the current passing at the time. Electric railway lines show generally four rails; two are for the carriage wheels, the third and fourth are electric, one usually being situated between the rails for the wheels, the other at the side of the track. The effect of coming into contact with an electric cable, wire or rail, is at once to deprive the individual of the power of motion, so that he cannot remove his hand, or whatever part of the body is in contact. Insensibility or death will certainly speedily supervene unless he is quickly rescued.

Treatment.—Remove the patient from the contact. The difficulty and danger in this is that whoever touches the patient may become equally affected and be rendered insensible or killed by the current passing through his body. If the helper is not insulated no good is done to the patient and the helper suffers.

Insulation means placing a non-conducting substance in such a position as to interrupt the electric current and prevent it from passing to the earth. This can be done by taking a non-conducting material in the hands, or by standing upon a non-conducting substance so that the current is prevented from passing to the earth. To insulate the hands a dry material may suffice; thoroughly dry it must be, as the electric current passes freely through any garment damp from perspiration, or wet from rain or moisture. India-rubber gloves, if available, should be put on; if not, open a rubber tobacco pouch, put the thumb into one pocket and the fingers into the other, and with this grasp the patient's clothing and pull him away. If nothing else is to hand, wrap a dry cloth round the hand, seize a dry walking-stick, broom-handle, or rolled-up map, or any piece of dry wood (not metal) and push the patient away. To insulate the body, stand on a dry piece of wood or glass; dry straw or hay, wood shavings, etc., will suffice. If the helper should happen to have on dry goloshes, or tennis shoes with rubber soles, insulation will be effected. Should nothing be at hand to insulate either hands or feet, the

helper should start running a short distance from the patient and, as he approaches the patient, jump from the ground, and whilst in the air (with both feet off the ground) kick the patient from off the contact.

When the contact is broken, the patient must be treated for insensibility on general principles, artificial respiration being performed if breathing has ceased.

Frostbite. — Exposure to extreme cold, especially when a high wind is blowing and appropriate clothing is not worn, causes destruction of the skin and tissues beneath by arresting the flow of blood in the blood-vessels. Frostbite effects are seen especially along the outer rim of the ears, or it may be the whole ear, the extremity of the nose, the fingers and the toes. The patient is not aware of the condition, as there is no pain, all sensation in the part being lost. The fact that the part is frostbitten is generally recognised by the bystander, the part being seen to present a pallid or waxy appearance, cold to the touch and lost to sensation.

Treatment.—Rub the part affected gently with snow, or with a piece of cloth or a handkerchief dipped in cold water; continue the friction until signs of circulation are re-established, which will be indicated by a return of the normal colour to the skin. The patient must not be brought near the fire, nor into a warm room, until the signs of frostbite have disappeared, otherwise there is a danger of the frostbitten part dying. When the part has recovered its vitality hot fluids, such as tea, coffee, or soup, may be given.

Chilblains.—Parts of the skin are apt to become inflamed from cold, more especially in children and young persons. The regions of the body usually affected by chilblains are the toes, heels, fingers, ears, or nose. A chilblain may occasion merely a slight redness, with much itching, or a blister may result which, should it break, forms "a broken chilblain."

Treatment.—In the early stage the circulation may be restored by gentle rubbing, and washing the part with spirits of wine, whisky, or menthol liniment, and applying zinc or boric ointment and cotton-wool. Should a blister form, it should be snipped, the part

dressed with a simple ointment, and covered with lint and cotton-wool. If an ulcer forms, a dressing of carbolic oil (1 in 40) will tend to soothe and heal it. Persons suffering from this ailment should consult a doctor as to constitutional treatment. To prevent chilblains the boot must be roomy, with square toes and stout soles, the socks thick and loosely knitted; a cork or horse-hair sole inside the boot is advantageous.

Blistered Feet and Hands.—When the feet are blistered by badly fitting boots or by long marching, the blister, if large, should be snicked at its edge by scissors, the fluid allowed to escape, and the part dusted over with some absorbent powder such as fuller's earth, boric powder, or oxide of zinc, and afterwards protected. Another plan is to transfix the blister by a needle threaded with a woollen, cotton, or silk thread; the needle should be made to enter at the outer margin of the blister, where it joins the skin, and to emerge at a corresponding point on the opposite side; it is then covered by cotton-wool, and when, after a few hours, it has been well drained, the dressing is removed and the threads drawn out. The part is then dusted with powder, or smeared with vaseline or zinc ointment, and covered over. If the irritation amounts only to a redness of the skin and no blister has formed, the part may be protected by a piece of plaster; or if even a blister has formed, and the march has to be continued on, say, the following day, the blister, which has been pricked and drained overnight, may, on the following morning, be protected as follows: Take a small piece of plaster about the size of a halfpenny or a penny piece; in the centre of the plaster cut a hole of a size corresponding to the blister; snick the edges of the outer rim of the plaster and of the margins of the hole cut in the centre, and lay it on the part, the hole over the blister; place a thin cobweb of cotton wool on the part exposed in the centre of the plaster; take another piece of plaster, slightly larger than the first, snick its edges deeply all round the margin, and lay it on the top of the piece already applied. This will be sufficient to protect the part, and will allow of the march being continued.

To *prevent* blistering of the feet: Morning and evening for some days before the march the feet should be washed in cold water, and afterwards rubbed over with spirits of wine. For long marches the boots worn should not be new; the socks should be free from holes and should not have been mended; the inside of the socks should be dusted with boric powder, or boric and salicylic acids in equal parts, before putting them on. Should the feet become tender, the soles of the feet should be rubbed over with yellow soap just sufficiently wetted to allow the soap to be sticky: it is well also to turn the socks inside out and rub the soles all over with yellow soap, especially in the neighbourhood of the toes and heels. If the feet continue to be very tender, well wetted soap may be smeared in the toes of the boots and applied also up the back of the boot and where the heel presses. After the march the feet should be washed first in warm and then in cold water, and spirits of wine (or brandy or whisky) rubbed over them.

Corns and Bunions, etc.—A *corn* should be pared, and if necessary protected by a piece of plaster with a hole cut in its centre and applied over it. A *bunion* is usually upon the inside of the big toe; it also may be protected by a piece of plaster with a hole cut in its centre so as to remove the pressure of the boot. Corns and bunions are wholly due to wearing "ready-made" and "pointed-toed" boots. So long as "the foot is made to fit the boot," as with "ready-made" boots and shoes, instead of "the boot being made to fit the foot," as with "hand-made" boots made to measure, so long will corns and bunions continue. *Hammer-toes* may be protected from friction by a piece of plaster; it is usually the second toe that suffers from this deformity. Treat as follows: Cut a strip of plaster 4 to 5 in. long and in breadth about ½ in.; fix one end of the plaster on the sole of the foot just behind the third and fourth toes; carry the plaster up between the second and third toes, twist it, so that the sticky side is downwards, and carry it over the projecting part on the upper surface of the offending toe, then bring the plaster down between the first and second toes, twisting it again to get the sticky surface inwards, and fix it round the inner side of the big toe

CHAPTER IX

THE NERVOUS SYSTEM

THE body possesses two nervous systems, the central nervous system, consisting of brain, spinal cord, and nerves, and the sympathetic or vegetative system.

THE CENTRAL NERVOUS SYSTEM

The **brain** lies within the cranium. When the surface of the brain is inspected it will be seen to present an undulating appearance, consisting of projections termed *convolutions*, with furrows between. When the brain is cut into it will be seen that the surface presents a grey colour, forming a layer over $\frac{1}{2}$ in. in depth, and that the central part is of a pearly white appearance. The grey material, when examined by the microscope, is seen to be composed of cells—*nerve cells*, and the white material of fibres—*nerve fibres*. The nerve cells are the active part of the brain, and are concerned with the originating of nerve force, will, memory, consciousness, and all the attributes pertaining to the effort of voluntary movement. The nerve fibres merely serve as the conductors of the nerve force originating within the cells. The mass of the brain is arranged into two groups, the large brain or *cerebrum*, and the small brain or *cerebellum*. The cerebellum is situated behind and below the cerebrum.

The *cerebrum* is divided into two sides—a right and a left *hemisphere*—by a cleft passing from the front to the back of the brain; the two sides are connected by bands of nerve tissue passing between them. The right and left hemispheres are well nigh independent of each other in their functions. Membranes (*meninges*) cover the brain, affording it protection and nourishment, and containing a fluid in which the brain floats.

The **spinal cord** passes from the under surface of the brain downwards through the large opening (foramen

magnum) in the occiput to reach the spinal canal in the backbone. By referring to p. 8 it will be seen that the spinal canal extends throughout the entire length of the spine, having the bodies of the vertebræ in front and the processes of the vertebræ at the sides and behind. The spinal cord does not extend to the lower part of the canal, but ends about the level of the first lumbar vertebra. The spinal cord is in size about the thickness of the forefinger; between it and the bony canal in which it lies, a space intervenes to allow of free movement of the spine without injury to the cord. From the sides of the spinal cord pairs of nerves (spinal nerves) issue and find exit through apertures between the vertebræ throughout the entire length of the spine.

The Nerves.—The nerves that issue from the brain are termed the *cranial nerves*. They are mainly concerned with the special senses. The nerve of smell —the *olfactory*—is distributed in the upper part of the nostril; the nerve of sight—the *optic*—which endows the eye with the power of the vision, is in the eyeball spread out as the retina; the nerve of hearing—the *auditory*—passes to the intricate apparatus of the ear situated deeply in the temporal bone in the base of the skull; the nerve of taste—the *gustatory*—is one of the nerves which give sensation to the tongue. The face is also supplied by cranial nerves with motion and sensation, the former presiding over facial expression and the latter imparting acute perception of touch to the lips, nostrils, eyelids and eyeball and to the ear passages. One nerve on either side, termed on account of its wanderings the *vagus*, and also known as the *pneumogastric* (*pneuma* = air, and *gaster* = stomach, from the fact that it goes to the organs of the chest and abdomen), plays an important part, inasmuch as it brings the heart, the lungs, the stomach and intestines and almost all the other abdominal organs into relation with the brain, so that injury or disease of any of them always affects the nervous system generally. The vagus nerve finds its way down the neck along the track of the carotid artery. The nerves issuing from the spinal cord are termed the *spinal nerves*, and are named cervical, dorsal, lumbar, sacral, and coccygeal,

according to the regions at which they find exit from the vertebral column. At their origin from the spinal cord the nerves present *two roots* which almost immediately become blended into a single track to form a nerve. If traced to its destination a nerve will be found to give off branches to supply the muscles and the skin; in the skin the nerves end in special organs endowed with the sensation of touch.

Sensory and Motor Nerves.—To understand aright the functions of these two sets of nerves the following illustration will suffice: When the sole of the foot is injured, tickled, etc., the sensation of pain or tickling, heat or cold, etc., is conveyed from the skin of the foot along the nerves of the lower extremities to the spinal cord; thence the sensation is transmitted to the brain and ultimately reaches the nerve cells upon the surface, where the sensation is appreciated. From these cells an order is transmitted by the nerve fibres passing from the cells along the brain and spinal cord, and hence by the nerves to the muscles of the lower limb, whereby the foot is withdrawn from the source of the irritation, be it a live coal, a needle puncture, a cut, tickling, etc. The nerves concerned in conveyance of the sensations from the foot to the brain are termed *sensory* or *afferent* nerves; the nerves carrying the direction to the muscles from the brain are termed *motor* or *efferent* nerves. On arriving in the brain *all the nerves of the body cross*, so that the nerves carrying sensations from the left side of the body terminate in the cells of the right side of the brain, and, vice versa, those of the right side pass to the left. Similarly the motor nerves having their origin on the right side of the brain cross to supply and act upon the muscles of the left side of the body, and, vice versa, the motor nerves from the left side of the brain pass to the right side of the body. It will be plain, therefore, that an injury to the right side of the brain will affect, or cause paralysis of, the opposite side, that is, the left side of the body, and, vice versa, in the case of an injury to the left side of the brain, the effect will be shown on the right side of the body. Paralysis arising in this fashion is termed *cross paralysis;* and differs from paralysis due to that

which arises when the spinal cord is torn, in which the paralysis affects both sides of the body symmetrically.

The Sympathetic System

This system is arranged in two long chains, one on either side of the bodies of the vertebræ, reaching from the base of the skull to the coccyx. It consists of nerve cells and fibres, as in the brain, but, instead of the nerve cells being grouped into a large mass as in the brain, the cells of the sympathetic system are collected into pairs of small nodules (*ganglia*) about the size of a pea or bean, each pair corresponding to a vertebra These nodules or ganglia are joined together by connecting nerve fibres, and from the ganglia issue nerves, which in the thorax and abdomen supply all the organs contained within these cavities. Sympathetic nerves also join the nerve trunks of the central nervous system, and proceed with them to the limbs and trunk. The sympathetic system supplies the involuntary muscles of the body, such as those met with in the alimentary canal, the passages of the lung, the heart and blood-vessels, etc.; it is concerned, therefore, with the processes of digestion, respiration, circulation and absorption. It differs in its activity from the brain, for whilst the functions of the brain are in abeyance during sleep, the sympathetic system continues its activity during both sleep and waking. One especially large group of sympathetic nerves is met with in the region of the stomach, and it is due to the effect upon this group of sympathetic nerves (the *solar plexus*) that a blow upon the pit of the stomach causes such marked symptoms. The condition known as shock, caused by a blow or other injury, is chiefly attributable to injury to the sympathetic system.

CHAPTER X

INJURIES TO AND AFFECTIONS OF THE BRAIN

THE brain is liable to injuries and diseases which give rise to a great variety of signs and symptoms, some of them very complex and difficult to understand. It is only necessary to know the general principles involved in order to render the first aid required in accidents and sudden illness.

INJURIES TO THE BRAIN

By a blow upon the head the brain may be severely shaken, and its functions disturbed and held in abeyance to so great a degree that the patient is rendered insensible, or unconscious, when he is said to be stunned, or suffering from concussion. When the blow is so severe that the skull is fractured and a piece of the broken bone is driven down upon and presses on the brain, not only is the patient rendered insensible or unconscious, but the pressure squeezes or compresses the brain and causes what is technically called compression. If instead of, or as well as, the bone being broken by the fall or blow, a blood-vessel is ruptured, the blood that escapes may accumulate between the bone and the brain and cause unconsciousness and compression. Similarly if there is anything pressing on the brain, be it "matter" (pus) in an abscess, or a foreign body such as a bullet, unconsciousness and compression result.

Unconsciousness. — In most injuries and many diseases of the brain, unconsciousness to a greater or lesser degree is the predominant feature.

Examination of an Unconscious Person.—When a person is unconscious from any cause, it is necessary to ascertain how deeply the brain is affected, or whether he is alive or dead. It is only by a systematic examin-

ation that this can be ascertained. Proceed as follows :—

1. Examine the Circulation.— Feel for the pulse at the wrist ; if no pulse is felt there, it may be sought for over the carotid artery in the neck, over the brachial artery in the arm, at the temple or elsewhere. If in none of these places a pulse can be felt, the hand may be applied over the region of the heart where the impulse of that organ may be felt, or if the ear is applied over the heart its beating may be heard. The examination of the heart, however, by either of these means is not likely to afford exact information to anyone except a doctor.

2. Examine the Respiration.—If the chest or abdomen is seen to rise and fall, indicating that breathing is present, the patient is known to be alive; but he may still be alive, though neither the pulse nor the heart impulse can be felt, nor any movement of breathing either seen or felt when the hand is placed on the chest or abdomen.

3. Examine the Pupils of the Eye.—In the centre of the coloured part of the eye (the *iris*, Fig. 84) is a round aperture by which the light gains access to the deeper part of the eyeball. This rounded aperture, termed the *pupil*, varies normally according to the amount of light to which the eye is exposed. When a bright light falls on the eye the pupil contracts, so that only a small aperture is left ; the deeper parts of the eye are thereby protected from being exposed to too bright a light. In a shaded light or in the dark, and also when the eyelids are closed, the pupil is enlarged or dilated, that is, the curtain (iris) is pulled back or opened. It is, therefore, seen that the pupil contracts (that is, narrows) in bright light, and dilates (that is, widens) in dull light. When a person is unconscious the eyelids are usually closed ; and when in the process of examination the eyelids

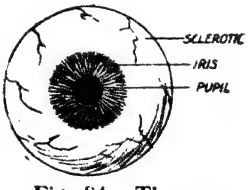


Fig. 84.—The eye.

are opened and the light is admitted, the pupils, if the patient is not too deeply unconscious, will be seen to contract, and the patient is known to be alive. If, however, the patient is very deeply unconscious, the pupil may not contract when the light is admitted, indicating that death either is threatened or has actually taken place. On raising the eyelids a difference in the size of the pupils may be observed: one may be contracted, and the other dilated, giving rise to what is termed *unequal pupils;* this sign indicates that one side of the brain has been more seriously injured than the other.

4. Examine the Scalp for wounds, and for any signs of the bone being depressed. The fact that the bone is depressed may be obscured by the bruising and consequent swelling of the tissues of the scalp.

5. Examine the Ears.—If from the aperture of one or both ears blood or a clear fluid issues, a fracture of the bones of the base of the skull, of which the ear-bone (temporal) forms part, is indicated.

6. Examine the Limbs for fractures, dislocations, wounds, paralysis, etc. Note if there is a difference in the laxity of the limbs on opposite sides of the body, a condition due to injury of one side of the brain, causing a greater laxity of the muscles on one side of the body than on the other. In this examination the meaning of cross paralysis must be remembered (*see* p. 130).

7. Examine the Trunk.—Injuries, bruises, fractures, stabs, etc., should be sought for in both the thorax and the abdomen.

8. Hæmorrhage from the nose and the mouth may or may not be present.

General Treatment for Unconsciousness.—In all cases of unconsciousness the patient is to be treated on the following principles:—

1. Lay him on his back in a position to ensure easy breathing. As a broad rule, when the patient's face is pale, keep the head low in a line with the body; when the face is flushed, keep the head up. The position of the head has to be watched very carefully when the patient is unconscious. If the head is raised by placing

the hand behind the head, the chin is pressed down towards the chest, and the windpipe being thereby bent or pressed upon, the breathing is obstructed. Should, on the other hand, the helper raise the upper part of the patient's body by passing the forearm behind the shoulders, the patient's head falls back, when the windpipe is bent and the breathing correspondingly obstructed. When raising the head of an unconscious person, therefore, attention must be paid to maintaining a free passage of air through the windpipe; by raising the head, neck, and shoulders together, so that the head is not bent sharply either forwards or backwards, the windpipe is kept quite straight.

2. Undo all tight clothing from the neck to the waist, unfasten the braces from the trousers in front, and the top button of the trousers. It is not expedient to remove the clothing if out-of-doors; but to see that the chest is free in front, the underclothing is torn or cut so that nothing lies in or across the middle line of the body from chin to waist. Unless the braces are unfastened in front from the trousers, the chest cannot expand, and artificial respiration cannot be satisfactorily performed. By undoing the top button of the trousers the movements of the abdomen in breathing are rendered more free.

3. Provide for a sufficiency of air. If out-of-doors, keep the crowd at a distance; if indoors, open the doors and windows so that a free current of air is provided. Fanning will help to produce a circulation of air round the patient's head.

4. Allow an unconscious person to remain for a time where he lies, protecting him from rain or from the direct rays of the sun by holding an umbrella over him. When signs of consciousness return, he may be placed on a stretcher and carried to shelter. If, however, after a reasonable time unconsciousness still continues, removal becomes imperative without waiting for revival.

N.B.—Under no conditions is any fluid to be placed in the patient's mouth, neither alcohol, water, nor sal volatile, nor any other medicine. Should any fluid be placed in the mouth during unconsciousness, it may

find its way into the windpipe instead of into the gullet and thereby cause death by suffocation.

Concussion.—In all cases of injury to the head causing unconsciousness, concussion plays a part. The man is said to be stunned, or in a state of concussion. In simple concussion, the brain is only shaken and there is no damage to its substance; its functions are merely in abeyance, and it is useless for the time being. If a watch is dropped its movements may stop, but after a shake or tap it again begins to tick and continues to do so, showing that there is no structural damage to the watch. Similarly, in concussion the working of the brain may cease for a few seconds or minutes and it resumes work, as no injury may have been done to it.

Signs and Symptoms.—The functions of the several systems of the body in slight or moderate concussion of the brain are disturbed, not arrested. The pulse flutters in its beat, the respirations are shallow, the pupils of the eye respond to light, and there may be little or no sign of a blow on the head, no bleeding from the ears nor signs of any injuries to trunk or limbs. In severe concussion all functions may be temporarily, almost completely, in abeyance.

Treatment.—Proceed on the general principles given above (p. 134). Loosen the garments and bare the chest from the chin downwards, ensure an easy position to breathe and a sufficiency of fresh air. It should be remembered that if the brain has been concussed and insensibility occurs for ever so short a time, the patient should be kept absolutely quiet for a period of at least three weeks.

Compression.—When a piece of bone or any foreign material presses upon the brain the patient is said to be suffering from compression. This is a much more serious condition than that of concussion, and although the brain is also concussed by the injury, the signs thereof are obscured by those of compression.

The signs and symptoms are in accordance with those recorded above. When the brain is pressed upon or compressed by bone, blood, a foreign body or by "matter" (pus), the functions of the body are reduced to a low ebb.

The heart beats slowly, the pulse being reduced to, it may be, only 40 beats per minute; the respirations are slow and the breathing stertorous, a noise being made as in deep snoring; the pupils of the eyes may be unequal if the brain is affected on one side only, but if both sides are injured, or if the unconsciousness is deep even when the injury is confined to one side, the pupils may be dilated equally and response to light be absent; the scalp wound may be open and show the depressed piece of bone, but the hæmorrhage may be so severe as to prevent its being seen. Hæmorrhage may occur from one or both ears, as well as from the nose and mouth; one side of the body may be more limp than the other, but the unconsciousness may be so deep that both sides are equally limp.

Treatment.—After examining the patient on the lines indicated at p. 133, lay him down in the position in which breathing is easiest, undo tight clothing, see that there is a free circulation of air around him. Arrest hæmorrhage from the scalp wound, if it is present, by a ring pad (Fig. 82, p. 106).

Affections of the Brain

Apoplexy.—It is seldom that young or middle-aged people suffer from apoplexy. About middle age the blood-vessels of the body begin to show signs of change; this consists of deposits of lime salts in the walls of the arteries, and according as these are deposited quickly or slowly, so do the chances of apoplexy increase and diminish. The vessels in old age no longer possess the elasticity of youth, but become more rigid, owing to the hardening of the walls, and thereby less able to expand and contract when a severe strain is thrown upon them. The heart, also, has more difficulty in driving the blood through these rigid tubes, and its muscular fibres are developed more strongly. It is evident, therefore, that when any severe strain is thrown upon these damaged vessels by people getting on in years, there is a danger of the brittle blood-vessels being ruptured, and the blood poured out into the surrounding tissues.

Although this may occur anywhere in the body, it is most likely to happen in the vessels of the brain, owing to their walls being less strong than those of arteries elsewhere.

Signs and Symptoms.—Although apoplexy frequently gives rise to symptoms that warn of its approach, it is usually only when the effusion of blood is so severe or extensive as to cause what is known as an "apoplectic fit," a "seizure" or "stroke," that it comes under the recognition of strangers or bystanders. The more special signs and symptoms to be noted are—(1) The advanced years of the patient. (2) The flushed or purplish (or very pale) appearance of the features. (3) Deep snoring or stertorous breathing. (4) The pulse may beat strongly but slowly. (5) The pupils of the eyes, if the effusion is on one side of the brain, as it usually is, will be unequal. (6) One side of the body will as a rule be more limp than the other, as only one side of the brain is usually affected. (7) The skin usually feels hot to the hand, as the temperature of the body in apoplexy is frequently raised. There will neither be signs of injury to the scalp, nor will there be an issue of blood from the ears, nose, or mouth.

Treatment.—Proceed on the lines given for unconsciousness at p. 134. Place the patient in a position to facilitate breathing; undo all tight clothing; allow of a free current of air. An ice-bag to the head will be useful, and hot-water bottles wrapped in a towel or a piece of flannel applied to the feet. Every freedom must be afforded to the act of breathing, and a current of air over the patient insisted upon. It is unnecessary to repeat that nothing must be given by the mouth. A severe apoplectic "fit" does not pass off for days or weeks, when consciousness may return, but paralysis (cross paralysis) may remain.

Epilepsy.—An epileptic fit is known under different names, the "falling sickness" being perhaps the most common. It is a disease of the brain which commences usually in youth and may continue to old age.

Signs and Symptoms.—A threatened attack may give signs of its approach. These are many and diverse. The patient may by his dull appearance or peculiar behaviour

indicate that an attack is threatening; the onset, however, may be sudden, the patient perhaps giving a cry, or other indication: or, again, the seizure may suddenly develop without any warning whatever, the patient falling in an unconscious state as if struck down. There is no employment or occupation that seems to determine the attack, and a seizure may occur anywhere, or at any time, night or day. It is the common form of "fit" met with in our streets. Unconsciousness obtains from the first, and may continue for a few seconds, a few minutes, or as long as a quarter of an hour or more. One attack may succeed another with great rapidity, or there may be intervals extending over days, weeks, or months. Seeing that there is no means by which we can ascertain when a fit is likely to come on, persons subject to this disease should never place themselves in perilous positions.

Essential signs and symptoms of an epileptic fit are —Unconsciousness, sudden onset, falling down and lying in whatever position the patient happens to fall. After a few moments of apparent arrest of breathing the patient stretches himself, takes a deep breath, and then the muscles all over the body speedily take on convulsive contractions, during which the hands, arms, and lower limbs are twisted in various ways, the muscles of the face are contorted, the tongue may be caught between the teeth and bitten, the eyeballs roll about beneath the closed eyelids, breathing may be noisy, and froth, tinged with blood if the tongue is bitten, may issue from the mouth and the nose. The patient may throw the arms about, or the limbs may be bent firmly to such an extent that the muscles may in some severe cases be torn. A common but not invariable sign is the thumb bent across the palm of the hand and the fingers clenched over it tightly. The duration of the seizure varies in length. An epileptic seizure is distinguished from every other kind of fit by the fact that the patient, although unconscious, throws the limbs about, and all muscles are in a state of spasm.

Treatment.—Treat as for unconsciousness (p. 134), and in addition prevent the patient from injuring himself by throwing his arms against articles of furniture, or

other solid bodies, by gently restraining but not altogether preventing the movements of the limbs or trunk; if the restraint is not gentle, owing to the violence of contraction the muscles may be torn, or even bones be broken. Wipe the froth from the mouth and nose. Place a pencil, a cork or a large piece of india-rubber wrapped up in a handkerchief, between the teeth. Leave the patient where he lies until the fit passes off; and when consciousness is fairly restored move him to shelter and allow him to go home, accompanied, if necessary, in case a second attack should come on. If the patient is placed in a vehicle he should be accompanied, especially if in a closed vehicle such as a four-wheeler or taxi-cab; but if no person can be found to accompany him the patient should be placed in a hansom cab, and the driver should be told to keep the window on the top of the cab open and to watch the patient, so that if a fit comes on he may stop the cab, remove the patient and lay him on the ground. On no account should the glass of the hansom be let down as the patient might fall forwards, and cut his head should the glass break.

Fainting.—In a crowded room in which the air becomes close it is a common thing to have to deal with patients who faint. The condition is often spoken of as a "fainting fit," but there is no convulsive movement or fit as in epilepsy; in fact, the patient remains quite still. Complete unconsciousness may or may not occur, but in severe faints it is always present.

The *signs and symptoms* are those of unconsciousness (p. 132). The special feature is the pallor of the face and lips, which at once gives the key to the condition. There is apparently cessation of breathing, and the pulse at the wrist fails; the patient is usually cold and the surface of the skin moist.

Treatment.—Lay the patient down at once, whether the faint is only threatening or has become complete. The pallor of face suggests that the brain is imperfectly supplied with blood, and, therefore, the clothing round the neck, chest and abdomen should be loosened; the head lowered if possible a little beneath the level of the body so that the blood may reach the brain more

easily. If in church, the patient should be laid on the seat or on the chairs quite flat, with the head low, but not laid on the floor in the pew. If in a ballroom, the patient should be laid on the floor at full length until consciousness is established. In a crowd in the street, he may be carried while still unconscious to an open space and there laid down. It is well, however, not to remove the patient when unconscious until some signs of vitality have returned, as will be evident by the lips and cheeks having their colour restored, or by the eyes opening. By raising the feet recovery will be hastened, as thereby the quantity of blood available for the heart and brain is increased. Fanning the face, the application of smelling-salts to the nostrils, or of cold water to the forehead, will favour recovery. The patient should be helped out of the room as quickly as possible, and placed in the open in a free current of air.

Hysterical Fits. — Patients liable to the disease hysteria may have severe outbursts, termed hysterical fits. The patient is not wholly unconscious, but throws the limbs, or it may be the whole body, about in a more or less purposeless manner. At times there may be crying, screaming, or laughter, and the patient may seize upon a bystander in a convulsive manner. There is little or no danger attendant upon a fit of this nature.

Treatment.—Stand away from the patient, try to induce control of the feelings by speaking sharply and decisively. If the fit is prolonged it is the custom to sprinkle cold water upon the face, or at times even to dash some cold water upon the face. This is usually successful. It is necessary that persons liable to these attacks should place themselves in a doctor's hands for constitutional treatment, for hysteria is a disease, and the "fits" are but indications of its presence.

Shock.—From severe physical injury or from mental emotion a shock to the system may ensue. A mental shock is to be treated for the most part in much the same way as a faint. Physical shock due to grave injury, as from extensive burns, fracture of a large bone, a dislocation, a severe wound, or crushed limb, causes

symptoms of a different type. Unconsciousness is exceptional, the patient being able, as a rule, to converse and tell the cause of his injury; the face will be pale, the skin cold; the patient complains of cold, and shivering may occur owing to the lowered temperature of the body.

Treatment.—Whatever the nature of the injury the patient should be kept warm, as it is a marked feature of shock that the temperature of the body is reduced. Before, during, or after the injuries are attended to the patient should be wrapped in any clothing available, coats, blankets, plaid, etc., and, as soon as possible, the patient being quite conscious, hot tea, coffee, milk, soup, etc., should be administered. Whilst he is being removed, and afterwards, the warmth should be kept up until the feeling of chill passes off. It is unpardonable to allow a patient to be conveyed upon a stretcher after a bullet wound, fracture of the thigh, or any severe injury, without at least a coat or a blanket being thrown over him.

Sunstroke and Heatstroke. — The term *sunstroke* is applied to the condition induced whilst marching with a heavy load in a hot sunshine. Sunstroke is very frequently seen among soldiers marching in column in full marching order when the weather is very hot and close. It occurs quite as frequently in temperate climates during hot weather as in the tropics. The patient during the march becomes feeble, the skin is pale, cold and moist; the pulse quick and weak; he will stagger and fall if not supported, complains of thirst, and may collapse. The condition induced is one of exhaustion owing to failure of the heart's action, or syncope. *Heatstroke*, or "heat fever," comes on more frequently at sundown, or immediately afterwards. If the patient has been working in, or exposed to, great heat during the day, and, especially if he has taken much alcohol, in the evening he may become very hot, the face grows red or livid, the temperature may rise to a dangerous degree, even to 107°, 110°, or over, and life is in extreme danger. Men working at the furnaces on board ship, especially in the tropics, are not uncommonly overcome with the heat, and, unless removed, speedily succumb.

Treatment.—Remove the patient to the shade; take the clothing off the upper part of the body; if he is not wholly unconscious place him in a sitting position; as quickly as possible pour cold water on the head and down the spine, and keep this up from time to time until the temperature is reduced, giving in the meantime, if he is conscious, ice to suck, or frequently repeating sips of cold water, but not allowing him to take a long draught of cold water. He should then be wrapped in a dry blanket, and allowed to rest in a cool place or apartment. Exposure to the sun (or hot furnace) should be avoided for some time to come.

When a person is overcome by the heat of a furnace remove him to the open air and apply cold-water douches. For Heatstroke coming on in the evening the patient is to be stripped, placed on a couch or bed, sponged with cold water, or wrapped for 20 minutes in a sheet wrung out of cold water and given ice to suck. Repeat the treatment at the end of an hour if the temperature again rises, and apply ice to the head.

CHAPTER XI

THE RESPIRATORY SYSTEM

THE lungs are the active organs by which air gains entrance to, and exit from, the blood in the blood-vessels. The air enters by the air-passages, and is drawn in through the nose (and occasionally by the mouth) to gain access by way of the larynx, windpipe, and bronchial tubes, to the ultimate recesses of the lungs. Of the several gases in the air, the most important are oxygen and nitrogen, present in the proportion of one of the former to four of the latter; it is the **oxygen** that changes the colour of the blood to a bright red by combining with the red corpuscles of the blood. In the recesses of the lung, the carbonic acid gas, brought hither in the venous blood by the pulmonary artery, is given off by the blood and finds exit by the air-passages during breathing. The **lungs,** right and left, occupy the greater part of the cavity of the chest; filling the chest to such an extent that it may be held that, wherever a rib can be felt, there is lung beneath. Each lung is enclosed by a delicate membrane termed the **pleura,** which is so arranged as to allow of free movement of the lung without friction. During breathing the cavity of the chest is filled and emptied at the rate of from fifteen to eighteen times per minute in health. The act of taking air into the lungs is termed **inspiration.** During the process the area of the chest is increased in dimensions partly by the raising of the ribs, but chiefly by the contraction and descent of the diaphragm. The process of expelling the air is termed **expiration,** during which the dimensions of the chest are diminished partly by the descent of the ribs, but chiefly by the ascent of the diaphragm. The **diaphragm** is the large muscular partition which completely separates the thorax from the abdomen; by its descent and ascent the capacity of the chest is increased and

diminished alternately. There are two types of breathing (*a*) the *thoracic*, by which is meant the expansion of the upper part of the chest; and (*b*) the *abdominal*, by which is meant the expansion of the lower part of the chest and abdomen. The former is termed the female type of breathing, the latter the male.

Artificial Respiration

When a person is recovered from the water and respiration is suspended, artificial respiration should be proceeded with. The length of time that a person may be submerged and yet live is unknown; but even after five or ten minutes, or longer, attempts at resuscitation should be made. Although all signs of respiration have ceased, although the pulse and the action of the heart cannot be made out, and although the pupils are widely dilated and do not respond to light, indicating a probability that death has supervened, it is impossible to say that resuscitation is hopeless. The length of time artificial respiration should be kept up is also unknown. But a short time ago, fifteen or twenty minutes was considered sufficient time to apply artificial respiration, but now it is known to be possible to restore a patient even after several hours of suspended animation; in fact, artificial respiration should not be discontinued until the temperature of the body falls to far below (say, 15 degrees) the normal temperature of the body.

When a person is pulled out of the water in an apparently lifeless state, one of the bystanders should be sent off to the nearest house to get help, the nearest doctor should be sent for, and the first messenger should bring back blankets, a change of clothing if possible, hot-water bottles, hot tea or coffee, and perhaps some stimulant, and, if it can be had, a vehicle in which the patient may be conveyed to the nearest shelter.

Whoever is left in charge should proceed to treat the patient, either single-handed or with the help of bystanders. There are several methods by which artificial respiration may be performed: for cases of apparent drowning Schäfer's is perhaps the best.

Schäfer's Method (Figs. 85 and 86).—Without wasting

time in loosening or removing clothing, except perhaps round the neck, lay the patient face downwards on the ground; turn the head to one side; bring the arms up on either side of the head palms downward; kneel with knees on one side of body opposite the hips, or, better, astride the patient; place a hand on either side just above the "small of the back," the thumbs directed

Fig. 85.—Schäfer's method: inspiration.

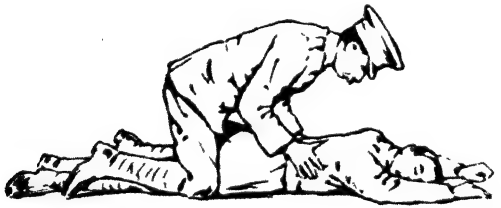


Fig. 86.—Schäfer's method: expiration.

inwards and close to the spine and the fingers well spread out so as to grasp the lower ribs; lean forward, keeping the arms stiff, and press upon the body steadily and firmly; by this movement the air is expelled from the chest, as well as any water which has found its way into the air passages. Without removing the hands, relax the pressure on the ribs, and fall back towards the heels; the air now enters the lung. These movements are repeated 15 to 18 times in the

minute; for the subsequent treatment for resuscitation, *see* Sylvester's method.

Sylvester's Method (Figs. 87 and 88).—(1) Lay the patient on his back; (2) bare the chest from the chin to the waist; (3) undo the braces in front and the top button of the trousers. The coat may be removed in a few seconds as follows: Turn the patient a little to one side, seize the bottom of the coat on that side, pulling it right up behind the shoulder to a level with

Fig. 87.—Sylvester's method: inspiration.

the top of the head; do the same on the opposite side. The collar of the coat is now pulled up from behind the back of the head; then pull the arms upwards above the head, seize the coat sleeves at the wrist, and slip the sleeves from the arms. (4) The mouth is opened, the tongue pulled forwards, and a strip of a handkerchief twisted into a cord, or a piece of tape or thick string, is passed over the tongue as far back as possible, and the ends tied firmly below the chin; the froth and water in the mouth and throat is cleared out as rapidly as possible with a handkerchief wrapped round the forefinger. (5) The patient is now rolled to one side and pushed well over, so that the face is downwards, with the brow resting on the extended forearm. Whilst he is in this position press upon the ribs at the lower part of the side of the chest that is uppermost with one hand, so as to empty the lungs of any water that may have been inhaled. (6) Lay a folded coat on the ground on a level with the patient's blade-bone, and turn the patient on his back,

If necessary, he may be rolled again and again upon the side and turned upon his back, the process being repeated two, three, or more times until the gurgling of water in the throat is no more heard. As the patient lies upon the folded coat his chest is thrown forward and his head and neck inclined backwards. (7) Kneel down with a knee on either side of the top of the patient's head, flex the patient's elbows, seize the tip of each elbow in the hollow of the hand; bring

Fig. 88.—Sylvester's method: expiration.

the elbows upwards and backwards until they strike the ground on a level with the patient's head (Fig. 87); bring the arms, still flexed and grasped at the elbows, forwards and downwards with a circular motion well forwards on to the sides, when the chest is compressed by squeezing the elbows inwards and slightly forwards against the ribs (Fig. 88). By the movement of the arms upwards the air is drawn into the chest, and when they are brought down and squeezed firmly against the chest the air is expelled. This process is repeated slowly, at the rate of 15 to 18 times a minute, that is, at the rate of normal respiration.

The success of the treatment depends upon the thoroughness with which the arms are raised and depressed. Unless the elbows are made to touch the ground in the upward movement, and unless they are forcibly squeezed against the side of the chest in the downward movement the proceeding is practically useless. It is especially the compression of the chest that requires the

closest attention. The part of the chest compressed should not be far back on the side, but well forward, the elbows being at the time of compression not more than 8 to 10 in. apart. It is well in performing the movement to count one, two, three. four, each figure counted representing a second of time ; it will thus be seen that as there are fifteen completed movements to be made in the minute, and as four multiplied by fifteen equals sixty, an exact gauge of the rate at which the movement is being carried out is ensured. As one person becomes exhausted, another may take his place and no interruption of the movement should be allowed, except, perhaps, occasionally turning a patient upon his side if there are signs of water gurgling at the back of the throat. The movement of artificial respiration may be performed by two persons, one kneeling down on either side of the patient, each moving an arm in unison.

As soon as there are signs of recovery, that is when the patient begins to breathe naturally, artificial respiration should cease; the ligature over the tongue is removed, and (8) efforts are now made to *restore the circulation*. (9) By this time, should the messenger have returned, a blanket is laid over the patient and under its cover the wet clothing is removed; he is then wrapped in blankets, and the limbs are raised and rubbed in a direction upwards towards the heart, so as to assist the passage of the blood through the veins (10) As soon as available, dry clothing should be put on, and the patient conveyed in a vehicle or on a stretcher to the nearest house. (11) He should there be put to bed, kept warm with hot bottles, etc., and given hot drinks. (12) If the breathing is difficult, or much hampered, a linseed-meal poultice applied to the front and back of the chest (with a light sprinkling of mustard over it) will tend to relieve the respiration. If the water into which the patient fell is of a foul nature, and some of it has been swallowed, as soon as he is strong enough to bear such a proceeding, an emetic may be given. Careful treatment and nursing may be necessary for a few weeks, until he is no longer in danger of inflammation of the lungs, etc.

Howard's Method.—Lay the patient on the back; place a folded coat behind and slightly below the shoulder blades; bare the chest in front; pull the tongue forward and tie it to the chin or hold it forward with finger and thumb or a forceps; mop out the back of the throat; kneel across the patient or on one side, on a level with the hip-joints; grasp the lower ribs in front on either side of the pit of the stomach, thumbs inward, points of the fingers outward, and directed slightly upward. Now squeeze firmly, bend forward, still compressing the chest until you almost touch the front of the patient's body; still kneeling, raise the body to the vertical position by pushing against the patient forcibly. The movements are repeated 15 to 18 times per minute.

Each of these methods has its advantages and disadvantages. Sylvester's method cannot be done if the arm is broken or the ribs are fractured. Both Schäfer's and Howard's methods can be carried out if a bone of the upper limb is broken, but not if a rib is broken. There is danger in Howard's method of too forcible compression and consequent breaking the ribs.

Laborde's Method.—This method is useful when the ribs are broken, and none of the previously described methods can be applied. The body is placed on the back with a folded coat underneath the blade-bones, the clothing is loosened, the head held in the middle line, the mouth opened and mopped out, and the tongue seized between the finger and thumb, or by a forceps. Thus held, the tongue is moved backwards and forwards 15 times to the minute. The air enters when the tongue is pulled forward, the aperture of the larynx and windpipe being opened by this movement.

Laborde's method may be used in conjunction with Sylvester's and Howard's methods, the necessity of tying the tongue being thus done away with.

Hanging and Strangulation

Hanging.—When a person is found suspended with the feet off the ground and a rope round the neck, pro-

ceed as follows: Clasp him round the thighs or legs; raise him sufficiently to take the weight of the body off the rope—this must be done at once; call for help; if this is not available release one hand, still holding up the patient with the other, and cut the rope; lower him on to the floor and remove the rope from the neck; loosen tight clothing and perform artificial respiration by one of the methods described in the preceding section.

Strangulation.—When a rope is carried round the neck and pulled tightly, the windpipe is occluded and the patient is suffocated. Remove the constriction from the neck, undo tight clothing, open the mouth, clear the throat, and perform artificial respiration.

SUFFOCATION

1. **By Smoke.**—A person in a burning house may be overcome by the smoke. To remove him from a room full of smoke the helper should take a handkerchief folded as a triangle, place the base of the triangle across the bridge of his nose, and tie it at the back of the neck; the point of the handkerchief hangs down over the nostrils and the mouth, thereby protecting him in some degree from inhaling the smoke. It is well to wet the bandage with vinegar and water, one part of the former to four of the latter. The helper, before entering the room, takes a few deep inspirations, so as to fill the lungs with pure air; he then bends low, or assumes a crawling position, and quickly enters the room to reach the patient. If the flames have not yet reached the room there may be time to open the window, or smash the window panes, and if the door is opened a current of fresh air through the room may be established. The patient is then removed, either (*a*) by pulling him along the floor, passing the hands from behind, beneath the patient's armpits, or (*b*), if there is time, by carrying him by the fireman's lift (p. 153).

If the flames threaten the patient, the helper, on entering the room, seizes him by the heels, or passes the hands below the armpits, and forcibly drags him out into the open, artificial respiration being applied afterwards by one of the methods (preferably Sylvester's) described above.

2. **By Gases.**—The fumes of poisonous gases, as from coal gas, charcoal fire, choke damp (to which miners are exposed), carbonic acid gas (sometimes met with in deep wells or ill-ventilated sewers), may cause suffocation, requiring, after the patient is rescued, the application of artificial respiration.

Fireman's Lift (Fig. 89).—When the patient is found lying on the back in a state of unconsciousness from smoke or from other causes, proceed thus: Turn him face downwards, bringing his arms down to his sides; kneel on left knee at one side of his head; raise the head and shoulders slightly; slip your hands under the patient's armpits from front to back; raise and rest him on your right knee; slip your hands lower down his back to the level of the waist and clasp them; stand up, raising the patient to an upright position with his head over your right shoulder; grasp his right wrist with your left hand; stoop down until your right shoulder is on a level with his hip-joints: carry his right arm round your neck, and pull the body on to your back; pass your right hand between his thighs and round his right thigh (or around both thighs if a woman), and, balancing the body, rise to the erect position. Then release your left hand from the patient's right wrist, and seize and hold his right wrist firmly in your right hand, which has been passed around or between his thigh or thighs.

Your left hand, being thus freed, is available as a means of holding on to a ladder, or for other purposes.

Choking

When a piece of meat, or other material, such as false teeth, or a piece of money, passes to the back of the throat and there sticks, proceed as follows: Open the mouth, pass the forefinger forcibly to the back of the throat, turn the finger downwards towards the openings of the windpipe and the gullet, bend the finger and attempt to hook up the foreign body. This may be repeated several times if necessary, and between the attempts the patient, whilst in a sitting position with the head well bent forward, may be thumped sharply between the shoulders. When the foreign body is dislodged artificial respiration may be necessary.

Fig. 89.—Stages of fireman's lift.

CHAPTER XII

THE DIGESTIVE SYSTEM

THE digestive system consists of the alimentary canal and the accessory organs.

Mouth and Gullet.—The food in the mouth is (1) torn and broken up by the teeth, (2) subjected to the action of the saliva, by which the starchy elements of the food are digested, (3) formed into a bolus preparatory to being passed along the throat and the gullet to the stomach, in the act of swallowing. The *teeth*, 32 in number in the adult and 20 in the child (milk teeth), are concerned in tearing and grinding the tougher elements of the food. The *saliva* is the actively digestive fluid poured into the mouth through several apertures from the *salivary glands*. The glands which secrete the saliva are arranged in three pairs along the lower jaw. (1) The parotid glands lie one on either side between the ear and the back part of the lower jaw, and their ducts open on the inside of the cheek. (2) The submaxillary glands can be felt beneath either side of the lower jaw; their ducts open beneath the tongue. (3) The sublingual glands and ducts can be felt as a ridge on the floor of the mouth when the tip of the tongue is turned in this direction. The principal action of the saliva is to convert the starchy elements of the food (bread, potatoes, vegetables, rice, etc.) by a process of fermentation into a form of sugar (glucose); the longer the food is kept in the mouth the better will it be digested, as the action of the saliva is thereby prolonged. Cooking renders the starchy particles more easy of digestion.

The **throat** (*fauces*) has on either side the *tonsils*; above is the soft palate, and below, the back of the tongue. When the food passes through the throat, it reaches a large bag, the *pharynx*; the upper part of the pharynx reaches above the level of the palate, and receives the

air during breathing from the back of the nose; here also a tube (Eustachian) on either side communicates with the ear. At the lower part of the pharynx two openings are met with; the opening in front leads into the air-passages by way of the *larynx* and *trachea*; the opening behind leads to the gullet (*œsophagus*), along which the food passes to the stomach.

The Stomach.—As soon as the gullet passes through the diaphragm to reach the abdomen it opens into the stomach, where the food is retained for a considerable time whilst it is being digested. The stomach lies immediately behind the region called the "pit of the stomach," at the lower end of the breast-bone which here ends in a narrow point consisting of cartilage (ensiform cartilage). The stomach in the adult measures about 12 in. from right to left, and about 3 to 4 in. across, when moderately distended. The food leaves the stomach by an opening on its right side, where a ringed aperture termed the *pylorus* acts as a valve and guards the passage into the intestine beyond. Whilst in the stomach the food is submitted to the action of the gastric juice; the main elements in this fluid which further digestion are *pepsine* and *hydrochloric acid*. Pepsine is a ferment which acts chiefly upon the ultimate elements of animal tissues, rendering the fibres and cells of the muscles (flesh or meat) into a substance capable of being absorbed into the body. This can only take place in an acid fluid, hence the presence of hydrochloric acid in the gastric juice. Before the food leaves the stomach it is converted into a thick, greyish, liquid mass termed *chyme*.

The Intestine.—The food passes from the stomach into a long tube measuring some 23 ft. in length; the first 17 ft. constituting the small intestine, and the lower 6 ft. the large intestine. The *small intestine* commences at the outlet from the stomach, which is guarded by the pyloric valve, and is termed the pyloric orifice. The intestine commences as a wide tube which gradually narrows. It is coiled to accommodate itself to the other organs in the abdomen. The first 9 in. of the small intestine is named the *duodenum*, the next 6 or 7 ft. the *jejunum*, and the remainder the *ileum*.

In the small intestine digestion proceeds, and the food is absorbed through its walls to reach the blood. An important addition to the digestive fluids gains entrance to the small intestine 4 in. after its commencement in the shape of the *bile*. The bile-duct not only conveys bile from the liver, but also the secretion from the pancreas. The small intestine ends in the large intestine just above the right groin.

The *large intestine* or *colon* starts from immediately above the right groin, where it exists as a bag (the *cæcum* or blind head of the colon), into which the small intestine opens. The aperture is guarded by a valve which renders it impossible for the contents of the large intestine to regurgitate into the small. Near the lower part of this bag is a small opening which leads into a worm-like tube some 4 to 6 in. long termed the *appendix*. From the cæcum the colon passes upwards towards the liver, then across the abdomen to the left side of the body to just below the spleen, thence it descends on the left flank to just above the left groin. These three portions are termed successively the *ascending*, the *transverse*, and the *descending* colon. From the region of the left groin the colon passes down into the pelvis, where it forms the *rectum*, and here the aperture of the exit (*anus*) terminates the alimentary canal. Of the accessory organs, the liver and gall-bladder and the pancreas are the chief.

The **liver** lies in the upper part of the right side of the abdomen, partially covered by the right ribs. It is in contact with the diaphragm above, and has the stomach, right kidney, and intestines below. It is a large, solid organ weighing between 2½ and 3 lb.; it measures about 12 in. from side to side, and some 3 or 4 in. in depth. It is largely concerned in the secretion of bile, which is conducted by the bile-duct downwards to the intestine, into which the bile finds entrance at the point referred to above. The **gall-bladder** is a small bag from 4 to 5 in. in length, and about 1½ in. across, lying on the under surface of the liver, and serves as a storehouse for the bile until it is required in the process of digestion; the duct from the gall-bladder joins with the bile-duct of the liver. The

bile is concerned with the digestion of the fatty elements (fat of meat, oils, butter, etc.) of the food; by its action the fats in the intestine are emulsified and rendered capable of being absorbed.

The **pancreas** (abdominal sweetbread) lies across the front of the spine immediately behind the stomach; it is some 8 in. in length, and some 2 in. thick. The fluid from the pancreas, termed the *pancreatic juice*, has many functions, being concerned with the digestion of the starchy ingredients of the food, of the animal tissues, and of the fatty materials, as occasion requires. The duct of the pancreas joins with the bile-duct, and the pancreatic juice and the bile enter the small intestine together, at a point 4 in. beyond the pyloric orifice of the stomach.

The Lymphatic System

In every organ and tissue of the body there exist *lymphatic spaces* and tracks from which minute channels and ducts convey a clear fluid termed the *lymph*. The ducts, named the *lymphatics*, are fine, thread-like channels of great length, richly endowed with valves; they serve to convey the lymph to the lymphatic glands. The *lymphatic glands* are grouped into three chief sets, the neck (cervical), the arm-pit (axillary), and the groin (femoral) glands; from these glands lymphatics again start and convey the lymph which has been modified by its passage through the glands to a central vessel termed the thoracic duct. The special lymphatics connected with the stomach and the intestines are termed the *lacteals*, referred to below as the means by which the digested elements of the food are absorbed in the intestines. The *thoracic duct* receives all the lymphatics and lacteals of the body. Commencing in the upper part of the abdomen in front of the spine, the duct, in size about the dimensions of whip-cord, passes between the spine and the diaphragm, and thence along the left side of the dorsal vertebrae in the chest to reach the root of the neck on the left side. Here the thoracic duct terminates in a large vein, and its contents are poured into the venous blood.

The course and distribution of the lymphatics will

be more readily understood by the following example: Should a wound of the finger be poisoned by septic (putrid) matter, narrow red streaks may be seen extending from the finger and the hand along the forearm and the arm to the neighbourhood of the armpit, where a large swelling may develop. The infection gained access to the lymphatic spaces in the finger, and the red streaks in the forearm and arm are due to inflammation of the lymphatics (lymphangitis). The swelling in the armpit is occasioned by inflammation of the lymphatic glands (adenitis), due to the poison entering the glands at this point. Here an abscess may develop. On the other hand, the poison may travel beyond the glands and gain entrance to the blood by way of the thoracic duct and thus give rise to blood poisoning (septic poisoning or septicæmia).

Absorption of Food.—The fluid elements of food are absorbed by the veins of the stomach and the intestines directly into the blood. The soluble salts, sugar, etc., also pass with the fluids into the venous blood. The more solid elements of the food, after digestion in the stomach and intestine, are mostly absorbed by the special set of absorbent tubes termed the *lacteals*, by which they are handed over to the lymphatic system and hence by the thoracic duct to the blood. The contents of the lacteals present a milky appearance, as the word lacteal (from lac = milk) implies.

CHAPTER XIII

THE EYE, EAR AND NOSE

The Eye

The eyeball consists of a spherical ball about 1 in. in diameter, protected by the bones of the orbit except in front, where it is covered by the eyelids.

When looking at the eye a coloured part *(iris)* is seen occupying the centre of the globe, and a white part *(sclerotic coat)* all around. In the centre of the coloured iris is seen a small, black, rounded aperture (the *pupil*) by which the rays of light reach the interior of the eyeball. Over the iris is a clear, tough tissue (the *cornea*), which covers the front of the eyeball as a glass covers the dial of a watch. Within the eyelids and over the white (sclerotic coat) part of the eyeball and cornea is a mucous membrane (the *conjunctiva*) which serves to keep the surface of the eye moist and allow of the easy movement of the eyelids upon the front of the eyeball (Fig. 90).

The light falling upon the eye traverses the cornea, passes through the pupil and travels backwards through the lens and the inner chamber of the eyeball to the back, where it is received upon the retina—an expanse of nervous tissue which communicates behind with the optic nerve—and by the nerve the image imprinted by the light is conveyed to the brain.

The pupil varies with the degree of light. In a bright light the iris closes in and the pupil is diminished so that the deeper parts of the eye are screened from the glare; when the light is dull or the eyelids are closed as in sleep, the pupils dilate widely. When the brain is injured on one side, the pupils become unequal or irregular, one being large and the other small. In deep unconsciousness both pupils may remain widely dilated, owing to the light failing to stimulate the retina and the brain. In several poisons the pupils behave

characteristically: in opium poisoning they are contracted, appearing as the "pin-point pupil"; in belladonna poisoning they are widely dilated and do not respond by contracting when even a bright light is brought to bear upon the eyeballs.

A foreign body in the eye is dealt with as follows: (*a*) When the foreign body is beneath the *lower* eyelid, place the thumb just below the lower lid and pull it downwards, when the eyelid will be everted and its inner

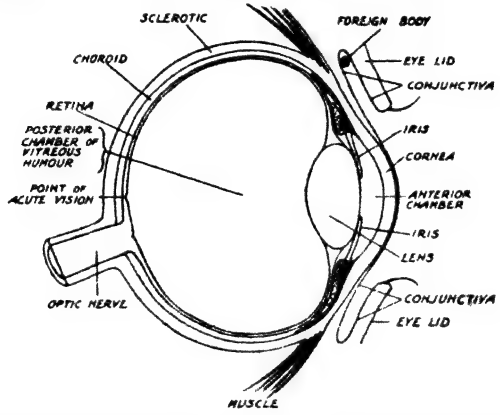


Fig. 90.—Section of the eye, with a foreign body beneath the upper lid.

aspect exposed: if the foreign body is seen, wet the corner of a handkerchief or piece of linen and wipe out the offending particle. (*b*) When the foreign body is beneath the *upper* eyelid, hold the upper lid by the finger and thumb applied crosswise to it; pull the eyelid forward from off the eyeball, and in the space thus made push up the lower lid so that the eyelashes of the lower disappear beneath the upper lid. Let go the upper lid and tell the patient to close firmly the eyelids. After a few seconds the patient is told to open the eyelids sharply, when the foreign body, if movable, may be removed. This process may be repeated again and

again if the first attempt is not successful. Instead of raising the upper lid as advised above, some prefer to remove the foreign body by seizing the lashes of the upper lid and pulling the lid down or over the lower lid. When the foreign body cannot be dislodged by this plan it may be necessary completely to evert the upper eyelid to find its presence.

To evert the upper lid proceed as follows: Seat the patient in a chair, put a towel or large handkerchief over the head; stand behind the head; lay a wooden match, or bodkin, shank of a darning needle, knitting needle, or surgical probe, or similar instrument across

Fig. 91.—Pad applied to the eye.

the upper part of the eyelid about ⅛ in. above the eyelashes; press the instrument backwards towards the eyeball; seize the eyelashes of the upper lid and turn the eyelid upwards over the instrument, when it will be everted and the inner aspect of the lid can be exposed and the foreign body removed with a piece of clean wet linen, or, holding the pointed end of a needle between the finger and thumb, remove the foreign body with the blunt end.

If a piece of steel has become embedded in the eyeball do not attempt to remove it, but drop a little (a drop or two) castor oil within the lower lid, or upon the upper lid if everted, and place a small pad over the eyeball

and a bandage to maintain gentle pressure (Fig. 91). The pressure should be sufficiently firm to give the patient comfort by checking the tendency to move the eyeball and lids. The same course may be taken if irritation continues after the removal of a foreign body.

When quicklime, acid or other caustic material injures the eye, the patient should immediately drop the face in a basin of water (hot or cold) to which some bicarbonate of soda (baking soda) has been added, and open and shut the eyelids frequently. Afterwards a drop or two of castor oil should be placed within the lids and the eye covered up.

The Ear

The apparatus of hearing consists of three portions —the outer or external ear, the middle ear, and the internal ear.

1. **The external ear** presents a series of elevations and depressions for the purpose of collecting the waves of sound and bringing them to focus at the ear-hole (the *external meatus*). The ear presents a rim or margin above and behind, a soft part—sometimes pierced for ear-rings—below (the *lobule*), and guarding the ear-hole in front is a lappet (the *tragus*), which, when pressed upon, closes the ear to the waves of sound. From the bottom of the ear-hole a channel leads inwards for 1¼ in. as far as a delicate membrane, which completely obstructs the passage, the ear drum (the *membrana tympani*).

2. **The middle ear** is separated from the outer ear by the drum. A chain of bones—three in number—touches the inner side of the drum at one end, and at the other impinges against the inner ear. A tube (Eustachian) from the front of the middle ear leads downwards to the bag (pharynx) behind the nose, and allows air to pass thence to the middle ear. The Eustachian tube is frequently blocked in catarrh of the nose (as occurs in a common cold), or by adenoids, when partial deafness results.

3. **The inner ear** apparatus is situated in that piece of the temporal bone (petrous) which forms part of the base of the cranium. The inner ear consists of canals

(semicircular), and of a spiral "sounding board" (cochlea).

Foreign Bodies in the Ear.—(*a*) An insect in the ear may be got rid of by laying the patient down—the "sound" side being on the pillow—pulling upon the rim of the ear to open the channel (*meatus*), and pouring half a teaspoonful of oil (warmed) into the passage. The insect will be thereby floated out. (*b*) A slate pencil, straw, or similar foreign body, if the end projects, may be withdrawn, and some oil poured in if the channel is irritated; if the straw, pencil, or other foreign body does not project, leave the removal to a doctor. (*c*) A button, pebble, bead, or pea (dry) in the ear should never be touched by anyone except a doctor. Unskilled attempts to remove it would threaten life, for the irritation thus caused not infrequently sets up inflammation of the membranes of the brain (meningitis), or of the brain itself. If the accident happens to a child, tie both its hands down to its sides, so that it cannot, by putting a finger in the ear, push the foreign body farther in.

The Nose

A foreign body in the nose, such as a shirt button, bead, orange-pip, etc., can generally be got rid of by causing sneezing, by administering a pinch of snuff, mustard or pepper, or by tickling the nostril with the rounded end of a hairpin passed up into the nose. If the foreign body is carried to the back of the nose, and drops down through the pharynx and is swallowed, a big meal of bread, potatoes, or porridge and milk may be given, followed by a dose of castor oil.

CHAPTER XIV

TREATMENT OF POISONING

ALMOST any substance may cause poisoning if misused; just as dirt is said to be matter in the wrong place, so even cold water, if swallowed in large quantities when a person is very hot, may cause serious or fatal consequences. That one man's meat is another man's poison is illustrated by the fact that of a number of persons partaking of a meal in common, some may show signs of poisoning, while others escape. Now it is fish or mussels, or lobster, or even so simple a fruit as gooseberries that occasions the poisoning. The signs and symptoms are many and varied according as the poison acts upon the digestive, the respiratory, the circulatory, or the nervous system. To endeavour to remember the antidotes to all the special poisons is a hopeless task, but certain broad rules, if once mastered, will serve in emergencies, and it is these broad rules which are given here.

The **general treatment** to be followed in cases of poisoning by food is:—

Administer an emetic to assist nature to get rid of the poisoned contents of the stomach, and *a large dose of castor oil* to sweep the poisons out of the intestines.

To produce vomiting, pass the forefinger well back to the root of the tongue and waggle it about; repeat this two or three times. If this measure is unsuccessful, add to a tumblerful of lukewarm water a tablespoonful of salt, or a dessertspoonful of mustard, and give it to the patient to drink. A request should be sent to the nearest chemist, if a doctor cannot be had, for an emetic, asking also for precise instructions as to how it is to be administered. In the case of children a teaspoonful of ipecacuanha wine, followed after a ten minutes' interval by a second dose,

and if necessary by a third and fourth, may be given as an emetic. During the intervals the finger should be passed to the back of the throat in order to provoke vomiting.

It is safe to give emetics in all cases of poisoning except when the lips, the tongue and throat are charred or burned by strong acids or caustic alkalis.

Treatment when the poison is unknown.—There are certain substances which it is safe to use in all cases of poisoning; these are—(1) milk; (2) raw eggs beaten up in water or milk; (3) olive, sweet or salad oil (except in phosphorus poisoning); (4) strong tea.

Treatment when the poison is known.—Milk, eggs, oils, or tea may be given in these cases, and special steps taken and remedies administered according to the specific action of the drug employed as a poison. *N.B.*—A doctor should be sent for at once, whether the nature of the poison is known or unknown.

Ptomaine Poisoning.—Foods may become poisonous from the development within them of certain ferments which act as poisons. Unsound meat or fish, mussels, sausages, pork pie, or pies made from other materials, are some of the more common foods thus affected. The *symptoms* are pain in the stomach, vomiting, purging, weakness, cramps, dilated pupils, and drowsiness, which may go on to collapse. For *treatment* give emetics, castor oil, hot tea or coffee to drink, and apply warmth externally.

SPECIAL POISONS

According to their specific action, poisons may be grouped under the headings of Narcotics, Irritants, Corrosives, and Deliriants.

Narcotics

Opium and its derivatives and preparations are the chief agents causing narcotic poisoning. Opium itself is obtained from the juice that issues from the head of the incised poppy capsule as it is ripening. Of opium the principal derivatives and preparations are—(1) morphia; (2) codeia; (3) laudanum (tincture of opium); (4) paregoric (compound tincture of camphor); (5)

Scotch paregoric (ammoniated tincture of opium); (6) syrup of poppies; (7) Dover's powder. Opium is also contained in several of the so-called soothing syrups given to children. Morphia, although usually administered hypodermically by dissolving crystals, tablets, or tabloids of morphia in water, and injecting the fluid, is also met with in the form of morphia lozenges, and given to allay cough. Codeia, too, is sold as lozenges for a like purpose. Chlorodyne and nepenthe both contain opium.

Signs and Symptoms.—Opium or one of its derivatives, when taken in excessive quantity, causes at first a slight exhilaration which speedily gives way to a feeling of comfort, and then sleepiness, increasing to a deep sleep, going on to coma, that is, a condition of profound insensibility; the features assume a pallid appearance; the pulse is abnormally slow; the breathing slow, deep, and stertorous; the pupils of the eye are contracted to such an extent that they appear as a mere pin point ("pin-point pupils"), quite insensible to light or shade; the breath, if opium has been swallowed in large quantities, gives off a musty odour.

Treatment.—An emetic is to be administered at once (p. 164), whilst the patient is yet conscious and capable of swallowing. The clothing is to be loosened, and the patient kept in a current of air; strong hot coffee should be given while yet consciousness remains; and the patient roused and prevented from going to sleep by every available means. The method most frequently practised is that of walking the patient about between two helpers, whilst the face, neck, and shoulders if bare, are slapped with a wet towel. The treatment may have to be kept up for several hours, or until a doctor arrives. When morphia has been administered in poisonous doses hypodermically (that is, by hypodermic needle beneath the skin) an emetic is useless, and there is nothing to be done except to endeavour to keep the patient awake until the doctor arrives.

Irritants

Most irritant poisons are also corrosive, that is, they not only irritate but may also actually destroy the

tissues with which they come in contact. The metals in ordinary commercial use are the best examples of irritant poisons.

The best-known **metallic poisons** are—*Arsenic*, known as white arsenic, or arsenious acid. It is present in Fowler's solution, emerald green, and various forms of vermin destroyers, such as rat-paste, fly-paper, vermin-killer, etc. Arsenic is employed in colouring wall-papers, artificial flowers, various forms of dyes, children's toys, cheap ices, and tinned fruits. *Antimony* is met with as a tartar emetic, butter of antimony, and several proprietary medicines. *Lead* enters into the composition of lead paint, white lead, sugar of lead, and several hair dyes. *Mercury* is largely used as a disinfectant, as corrosive sublimate (perchloride of mercury); it is also largely employed in photography. *Phosphorus* is used in making matches and in several poisons for rats and other vermin. *Zinc*, as white vitriol and the chloride of zinc, is a disinfectant.

Signs and Symptoms.—All the metallic poisons, when swallowed in poisonous doses, cause a burning pain in the throat and stomach; vomiting and retching; and a metallic taste in the mouth. These symptoms are followed by cramps, purging in several instances, cold sweats, exhaustion and collapse, ending in a convulsive seizure or coma.

Treatment.—Give an emetic; milk or draughts of water; beaten-up eggs; olive oil in tablespoonfuls, and cups of strong tea. The emetic may be repeated after one or several of these substances have been administered. Poultices applied over the pit of the stomach and barley water to drink will relieve pain and thirst. In phosphorus poisoning, owing to the fact that this metal is readily dissolved in oil, no oily or fatty substance should be given.

Corrosives

These include several of the metallic irritants mentioned above, but the chief examples of corrosive poisons are the acids and the alkalis. The **acids** in common use are sulphuric acid (oil of vitriol), hydrochloric acid (spirit of salt), nitric acid (aqua fortis): these three are

mineral acids; oxalic acid (salts of lemon or sorrel); carbolic acid; acetic acid (aromatic vinegar and glacial acetic acid). Of these, carbolic acid is largely used as a disinfectant in surgical dressing, oxalic acid is employed in removing stains from linen, and the several mineral acids are in frequent use for their chemical and their corrosive properties, especially in removing growths, etc., from horses, cattle and sheep. Some of them are also employed in polishing steel and removing rust.

Signs and Symptoms.—The lips, mouth, throat, gullet, and stomach are burnt and discoloured; pain along the whole track from the mouth to the stomach is severe; and usually signs and symptoms of suffocation are present owing to the entrance to the air passages being occluded by swelling of the mucous membrane of the parts around. All of these acids present some special feature by which it is possible to determine which of them has been taken as a poison. Hydrochloric acid stains the mouth with a white coating, nitric acid gives a yellow colour, and sulphuric acid a blackish appearance to the tongue, cheek and gums. Carbolic acid can be recognised by the odour of the breath; oxalic acid by the vomiting of a dark-coloured fluid, whilst the mouth is stained white; acetic acid by the odour of vinegar in the breath; as the patient usually attempts to get rid of the poison by spitting it out, the lips are swollen, stained and burned, and the chin and neck may be similarly affected. The skin of the hands also may be stained and seriously destroyed.

Treatment.—Do not give emetics. Administer milk, beaten-up eggs, olive oil, and gruel. Alkalis, being chemical antagonists to acids, may be given either alone, or along with milk or gruel for the mineral acids. Lime water may be given in the milk or gruel, in the proportion of a tablespoonful to a tumblerful of milk or gruel. Fluid magnesia may be similarly administered. Other alkaline substances are chalk (it may be plaster from the wall or ceiling), whiting, carbonate of soda, etc., dissolved (or broken up) in a small quantity of water. These should be administered in frequently repeated teaspoonful doses, thereby avoiding dangerous distension

from carbonic acid gas, consequent upon the action of the acids upon the carbonates contained in these substances. In carbolic-acid poisoning, Epsom or glauber salts (sulphate of magnesia) may be given in sips, in the proportion of a tablespoonful of the salt to a tumblerful of warm water. In oxalic-acid poisoning give chalk or magnesia in a quantity of water, and a purge of castor oil to follow. The administration of demulcent drinks, such as gruel, barley water, milk, and lime water, is to be continued for several days. Should signs of suffocation be present, treat as for scalded throat (p. 123).

The **alkalis** in common use in our nurseries, namely lime water and fluid magnesia, are harmless; but alkalis such as caustic potash and soda, strong ammonia, and quicklime may cause corrosive poisoning.

The *signs and symptoms* are burning pain in the mouth, throat, and stomach; stains upon the lips and chin, and sometimes on the fingers, are present; retching, purging, suffocation, and signs of collapse may follow. The tongue when a strong alkali is swallowed is bared of its covering and presents the appearance of raw beef; a different condition altogether from that met with in acid poisoning, when the tongue and mucous membranes of the mouth and throat are thickly coated and are black, yellow, or white in colour, according to the acid taken.

Treatment.—N.B. Do not administer an emetic. Give milk, beaten-up eggs, olive oil, orange juice, lemon juice, or vinegar and water (a tablespoonful to a tumblerful of warm water), frequently sipped. If suffocation threatens, treat accordingly.

Deliriants

Belladonna is most frequently met with in the form of atropine or sulphate of atropia—the active principle. Belladonna is the product of the deadly nightshade, a common plant in woods or hedges.

Signs and symptoms are dilatation of the pupils, dryness of the mouth and throat, flushed face, and delirium.

Treatment.—Give an emetic, strong coffee, alternately hot and cold douches, perform artificial respiration,

and apply a mustard leaf or plaster to the calves of the legs, over the abdomen, heart, etc.

Henbane.—In the form of hyoscyamus this poison presents much the same symptoms as belladonna, and requires similar treatment.

Strychnia, or the seeds of nux vomica from which it is derived, is largely used as a "vermin killer"; it causes after five or ten minutes a feeling of choking, with stiffness of the muscles in the legs and other parts of the body. The poison has a bitter taste.

The *symptoms* are the onset of restlessness, great excitement, convulsive spasms, lockjaw, difficult breathing, and finally collapse.

Treatment.—At once, before the spasms have commenced, give an emetic; keep the patient absolutely quiet, perform artificial respiration if death seems imminent.

Aconite.—Any part of the "Monkshood" plant (*Aconitum napellus*), sometimes called "wolfsbane" or "blue rocket," is poisonous. Liniment of aconite, in common use in cases of neuralgia and rheumatism, may be swallowed in error.

The *symptoms* are tingling of the lips, burning pain in the gullet and stomach, numbness of the skin, heart failure, and difficulty in respiration.

Treatment.—Give emetics, strong tea or coffee, keep patient quiet, apply warmth to the body, and artificial respiration if necessary.

Amongst a host of possible poisons met with more especially in woods, gardens, and hedgerows may be mentioned the following: (1) **Laburnum seeds** cause vomiting, purging, convulsions, drowsiness and insensibility; give emetics, purgatives, and apply hot and cold douches alternately to the head and trunk. (2) **Holly berries** cause vomiting, purging, pains in the stomach, contraction of the pupils, drowsiness, and collapse; treatment as for laburnum poisoning. (3) **Ergot of rye** produces cramp and a feeling of "needles and pins" in the extremities, vomiting, purging, itching, giddiness, and collapse; give emetics, strong tea, castor oil, and keep the patient warm in the recumbent position. (4) **Fungi,** or poisonous mushrooms, set up

colic, vomiting, purging, stertorous breathing, dilated pupils, and some delirium; give emetics and castor oil, and apply warmth to the extremities and the abdomen.

Alcohol.—Poisoning by alcohol may be caused by a large quantity taken quickly, by the drinking habit, or by the effect of alcohol upon a person in a feeble state due to starvation.

(1) When a large quantity is quickly drunk, the patient passes speedily through the stages of excitement to one of stupidity and coma. The smell of the breath, combined with the flushed and congested face, altered and fixed pupils (dilated or contracted), indicates what has happened. *Treatment.*—Emetics and strong coffee should be given at once, before insensibility occurs, followed by alternate hot and cold douches, and other attempts made to rouse the patient; the body must be kept warm by coverings and hot bottles, as alcohol rapidly lowers the temperature of the body.

(2) Chronic alcoholism seldom requires first aid. Treatment as for lunacy is the only cure.

(3) "Collapse from drink" is most frequently seen in the case of a poor, ill-fed, wretchedly clothed person in the street, who, begging for alms, and receiving a small sum, hopes to obtain more immediate comfort from alcohol than from food, and visits the public-house for the purpose. At first there is a feeling of comfort and "well being," but in half an hour this passes off, and is succeeded by drowsiness, deep sleep, and collapse. Such a person may be found in cold weather huddled on the door-step. The skin is cold, pale, and clammy; the pulse may be absent from the wrist altogether, or it may beat very feebly; the breathing is slow and stertorous (as if snoring deeply); the pupils are dilated, and may or may not respond to light, according to the amount of insensibility; the temperature of the body may be as low as 92° or lower, the general appearance of emaciation and scant clothing, combined with the odour of the breath, help to point out what has happened. The person need not be, and often is not, a drunkard, but one on whom even a small amount of alcohol has had an undue effect, owing to a state of starvation.

Curiously enough, this state is not infrequently confused with the effects of an apoplectic (fit) stroke, and with dire consequences to the apoplectic patient, who may be taken to the police-station and die in a cell. To distinguish between conditions so apparently distinct would seem easy, but seeing how frequently the newspapers give accounts of such mistakes, there would appear to be some peculiar difficulty. The following table of differentiating features may be useful:—

	COLLAPSE FROM DRINK	APOPLEXY
Age.	May be a young person.	Middle-aged or older.
Face.	Pale.	Flushed.
Temperature.	Below normal.	Above normal.
Pulse.	Feeble or absent at wrist.	Slow and full.
Breathing.	Stertorous; breath smells of alcohol.	Stertorous.
Pupils.	Equal.	Unequal as a rule.
Consciousness.	Can be roused.	Cannot be roused.

Treatment.—In collapse from drink, administer an emetic if the patient is not too far collapsed; apply warmth to the body and smelling salts to the nostrils; when the power of swallowing returns give hot drinks—tea or coffee—and suitable food.

CHAPTER XV

BANDAGES AND SLINGS

The Triangular Bandage

An ordinary handkerchief folded crossways so that one corner is brought to lie directly upon the corner opposite to or farthest from it constitutes a triangular bandage in miniature. A large handkerchief, such as a full-sized bandanna, may be used as an efficient triangular bandage when occasion demands.

Size.—Regulation triangular bandages are made of definite sizes. They are cut from material measuring 36 in. square, or of larger dimensions up to even 42 in. square. The latter measurement will be found best suited for general purposes, and therefore all bandages used for practice should be cut from material 42 in. square. To make a triangular bandage, form a square, cut from one corner to the opposite corner, or fold the square to form a triangle and cut along the folded part. Starting with a piece of material 42 in. square, the measurement of a triangular bandage from end to end along the base is 5 ft. With a bandage of 36 in. square, the bandage from end to end along the base is 4 ft. 2 in.

Materials for Bandages.—1. *Cotton* is the most commonly used material from which triangular bandages are made. It may be in the form (*a*) of unbleached calico, which is brownish-yellow in colour, and, owing to the dressing it contains, is rather too stiff to be comfortable until it has been used or washed; or (*b*) of bleached calico or cotton sheeting, white in colour, more pleasant to wear and more adaptable in application than the unbleached material.

2. *Linen* is seldom used owing to its expense, but it makes excellent material for bandages.

3. *Silk* we see used, in the form, say, of a black silk neckerchief, for a sling; it is too expensive, however,

for general use, and although the colour renders it less conspicuous than a sling of white cloth, there may be a disadvantage in its being black, inasmuch as it may be dirty without showing it.

The various parts of the triangular bandage are (*a*) the apex or point; (*b*) the base or lower border

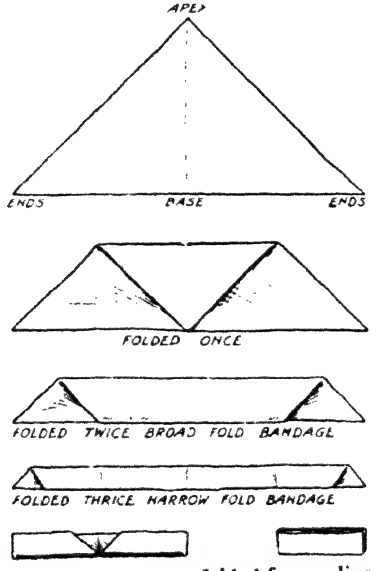


Fig. 92.—Triangular bandage folded for application. The two lower figures show the bandage folded for packing.

(*c*) the two sides; (*d*) the two ends; (*e*) the two surfaces. There is no difference in the texture or appearance of the surfaces of the bandage, but when applied they are termed the inner (that next to the skin) and the outer surfaces respectively.

Folding the Triangular Bandage.—The bandage, when unfolded, is referred to in the text as the "unfolded" or "open" bandage.

1. To fold the bandage for application, lay it on a flat surface with the apex away from you (Fig. 92). Stand at the base and fold the bandage by doubling it, bringing the apex towards you to the centre of the base. Double it again by bringing the farther-off border to the base, when the bandage is said to be a "broad-fold bandage." Double the bandage again by bringing the

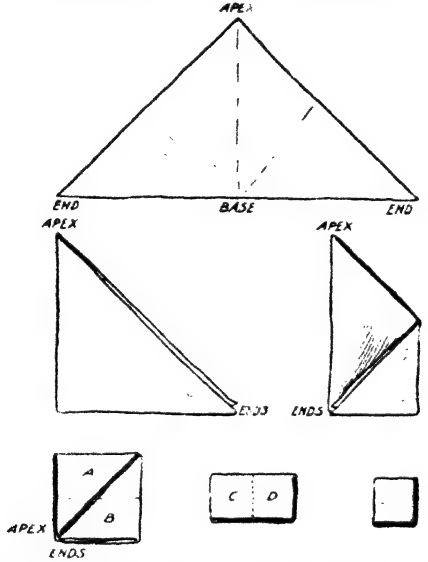


Fig. 93.—Triangular bandage folded for packing.

farther-off border to the base, when the bandage is said to be a "narrow-fold bandage."

2. To fold the bandage for packing there are two methods: (*a*) Bring one end over to cover the other end—a smaller triangle is thus formed, with the new apex at the centre of the base (Fig. 93); bring the corners (the old apex and the two ends) to the new apex (old centre of base)—the bandage is now a square; fold A over B (Fig. 93), when an oblong is formed;

double the oblong lengthwise, C over D (Fig. 93), when a square results. In this form the bandage is most readily packed in quantity. When intended to be put in the pocket, the small square thus formed should be doubled again. A safety pin (or pins) should always be inserted in the bandage, for use in application when it is required to be pinned to keep the edges in position.

(*b*) Lay the bandage out with the apex away from you; next fold it so as to form a narrow-fold bandage (Fig. 92); bring the two ends to meet in the centre; again bring each extremity to meet in the centre; double the bandage upon itself, when an oblong is formed. The advantage of this method is that the latter is ready for use, when undone, as a narrow-fold bandage, and is readily put in the pocket.

To Secure the Bandage Ends.—(1) *By tying.*—A reef knot should always be employed in fastening off the ends of a triangular bandage. The granny knot—the ordinary knot used in tying string, etc.—is apt to slip, and should never be used in surgical work. The difference between the two will be gathered from the diagram

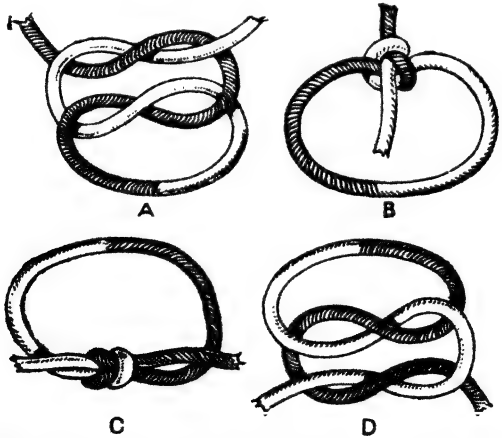


Fig. 94.—A, B, Granny knot; C, D, Reef knot.

(Fig. 94). When completed it will be seen that in the case of the granny knot the ends lie at right angles to the course of the bandage, but with the reef knot the ends lie parallel to the bandage and are readily tucked away. To practise making a reef knot, pass a narrow-fold bandage round your own or another person's neck, make the first half of the bandage—this is the same for either a granny or a reef knot. It will be observed that in the half knot thus tied there is an upper and a lower end to the bandage. Bring the upper end across the lower end, and with it (the upper end) complete the knot. The ends when pulled will be found lying parallel to the course of the bandage. It will thus be seen that in making the second half of the reef knot the upper end is made to do the work, the lower end being kept steady. The reverse is the case in the second half of the granny knot; it is the lower end that is made to do the work, the upper end being passive.

Tucking the ends of the bandage away out of sight after the reef knot is completed is a necessary part of applying the bandage; when the bandage is completed the ends should never be seen. In some diagrams the ends are visible; this is done on purpose to show where the knot should be, and it is not intended to indicate that leaving out the ends is ever correct.

(2) *By pinning.*—Safety pins should always be used, when possible, to secure the ends of a triangular bandage when tying is impossible: and to secure the apex in place pinning is usually necessary. Including the apex between the halves of a knot is another plan of securing the apex when pinning is inadvisable or when pins are not to hand.

Slings

In practising the application of the triangular bandage as a sling for the upper limb the patient is supposed to be standing with the upper limbs hanging by his sides.

Large Arm Sling. — *Method* 1 (described as for left upper limb).—Stand in front of the patient. Hold the apex of the bandage in the right hand and one end in the left; lay the bandage on the front of the body,

placing the apex between the left side of the body and the left elbow; carry the end held in the left hand over the right shoulder, round the lower part of back of the neck, and bring it forwards over the left shoulder to a point 3 in. below the left collar-bone (Fig. 95 A); bend the elbow and lay it on the bandage with the hand somewhat higher than the elbow (Fig. 95 B);

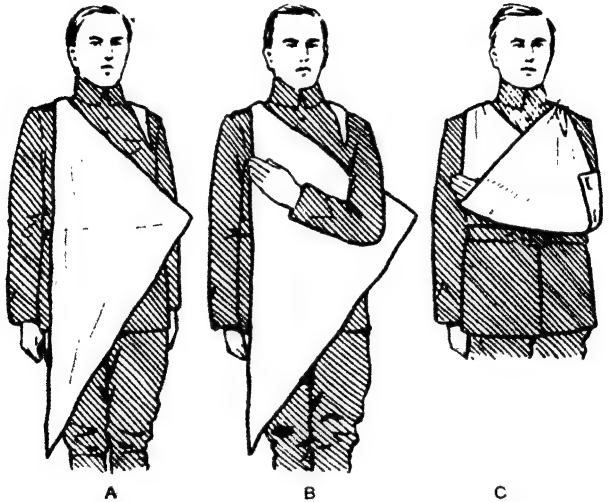


Fig. 95.—Large arm sling: method 1.

bring up the lower end of the bandage over the flexed forearm, and tie the ends just below the left clavicle. The apex of the bandage behind the elbow is now brought forward over the lower part of the arm and fixed by two safety pins (Fig. 95 C).

Cautions.—(*a*) When the bandage is applied the edge (base) should be brought to the root of the nail of the little finger, so that all the finger nails are exposed, and by their appearance the state of the circulation in the hand and upper limb generally

can be gauged. A bluish congestion of the nail, showing that the circulation is being interfered with, requires alteration of the position of the hand or removal of the sling altogether, and maintenance of the hand in a position in which the circulation becomes quite free. (*b*) The knot of the sling must not be placed on the back of the neck, nor on the opposite side of the neck from the injured limb. At both these positions it presses uncomfortably on the skin, as the drag of the bandage is on these points. This is not apparent at first, but, when a sling has to be worn all day the knot, unless placed well forward on the *same* side as the injury, soon makes the skin beneath it tender; with the knot, however, in the position recommended, the more the bandage drags the more is the knot pulled from off the skin. (*c*) See that the bandage is kept as low down at the back of the neck as possible, and below the collar if a coat is worn. To keep the bandage down from off the neck, it is advantageous at times, especially in children, to fasten the bandage by a safety pin behind; by pinning it at the back of the neck it is also prevented from getting into a ruck, which renders a sling tiresome to wear and most uncomfortable.

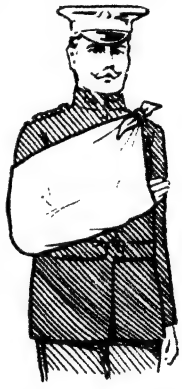


Fig. 96. — Large arm sling: method 2.

Method 2 (described as for right arm).—This method is applicable when the upper limb is injured, and the patient dreads its being touched or moved from the position in which the forearm is maintained at a right angle to the arm. Stand in front of the patient. Without moving the forearm as it lies across the body, lay a triangular bandage on the front of the body and forearm, carrying one end over the shoulder of the sound (left) side; gathering up the lower end of the bandage, carry it beneath the bent elbow round the right side of the body, across the back to the top of the sound (left) shoulder, where it is tied off;

the apex of the bandage is now passed behind the elbow and fastened by two safety pins to the bandage behind (Fig. 96); or it may be brought forward and pinned. This bandage has the advantage that (*a*) the limb is not touched or handled in any way; (*b*) the drag of the bandage on the back of the neck is avoided; (*c*) the position of the knot is not so important, as the limb is partly supported by the body.

Method 3.—Another method of applying a sling is described under Fracture of the Clavicle, p. 49.

Narrow Arm Sling.—When the arm (humerus) is fractured, and in cases in which the hand only requires support, a narrow arm sling is to be applied. Fold the triangular bandage so as to form a broad-fold bandage [*N.B.*, the broad-fold bandage forms a narrow arm sling]. Proceed as follows (for the arm): Standing in front of the patient, lay one end of the bandage across the sound shoulder, bring it round the back of the neck to below the clavicle of the injured side; bend the elbow so that the forearm is at a right angle to the arm, and lay the hand in the bandage; bring up the lower end and tie off below the clavicle of the injured side. The bandage should be passed so as to support the lower part of the forearm, the wrist, and the hand, as far as the root of the fingers (*see* Fig. 100).

Bandage for the Hand.—Spread the triangular bandage flat upon a table or other support with the

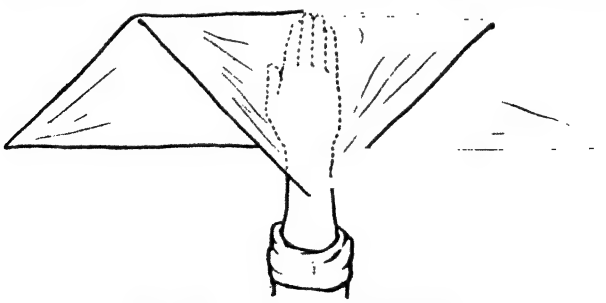


Fig. 97.—Bandage for the hand.

apex away from the patient. Place the open hand, palm downwards, 3 in. from the base of the bandage; bring the apex up over the hand, wrist, and lower part of the forearm (Fig. 97); gather the ends together, cross them over the back of the hand, and pass them round and round the wrist, tying off on the back of the wrist. Bring the apex down over the knot and secure it with a pin to the bandage over the back of the hand (Fig. 98). If no pin is at hand, the apex may be fastened as follows: After tying half the knot bring the apex downwards over it and complete the knot, the apex being secured between the halves of the knot.

Fig. 98.—Hand bandage completed.

Bandage for the Wrist.—When the wrist is sprained or otherwise injured, place the palm of the hand in the centre of a narrow-fold bandage; gather the ends together and carry them round the hand (leaving the thumb free), cross the bandage over the dorsum (back or posterior aspect) of the hand and wrist, and round and round the wrist and lower part of the forearm, and tie off on the back of the limb.

Bandage for the Elbow.—To keep a dressing on the elbow, when the limb is straight or the elbow bent, lay the open triangular bandage on a flat surface; fold 3 in. of the lower border on the main part; lay the bandage on the elbow, with the apex half way up the back of the arm, the base (with the folded edge next the skin) just above the middle of the forearm. Gather the ends together, cross them over the front of the elbow, bring them to the back of the limb above the elbow, pass them round and round the arm 3 in. above the elbow, and tie off behind. Bring the point down over the knot and elbow and pin off on the back of the forearm (Fig. 99).

Bandage for the Shoulder (left).—Two bandages are required. Stand opposite the left shoulder; lay the apex of a triangular bandage just below the left ear. Fold the lower border (bare) inwards to the

extent of 3 in.; gather the ends together and bring them round and round the arm 1 in. above the lower border of the bandage. Apply a narrow arm sling

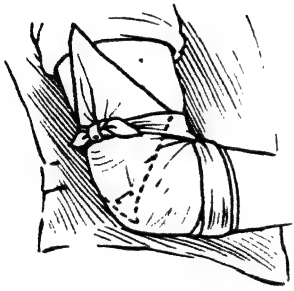
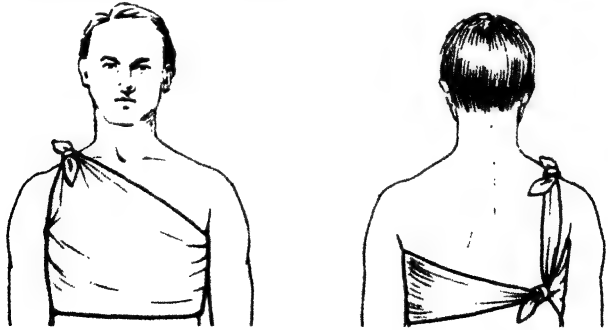


Fig. 99.—Bandage for the elbow.

Fig. 100.—Bandage for the shoulder.

with the knot on the top of the shoulder. Bring the apex down over the knot and pin it to the bandage over the outer part of the shoulder (Fig. 100).

Bandage for the Chest.—To keep a dressing on the chest, stand in front of the patient; lay the triangular



A B

Fig. 101.—Bandage for the chest.

bandage (open) on the front of the chest with the apex well over one (say the right) shoulder (Fig. 101, A). Turn the lower border inwards for 3 in.; gather the ends together and carry them round the patient's body to the back. Tie the ends behind in a vertical line from the right shoulder, the longer end, after the knot is tied (which will be in this case the right), is brought vertically upwards and tied to the apex on the top of the right shoulder (Fig. 101, B).

Bandage for the Back.—To keep a dressing on the back, stand behind the patient; lay the triangular

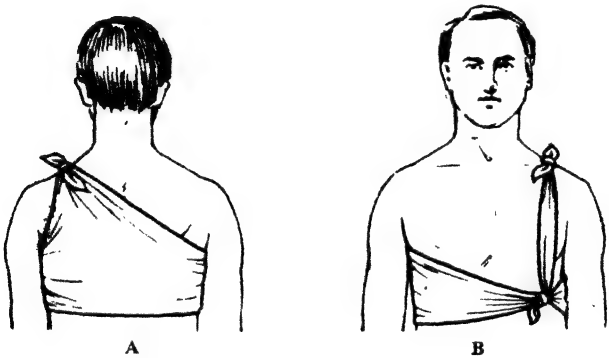


Fig. 102.—Bandage for the back.

bandage (open) on the back with the apex well over one (say the left) shoulder (Fig. 102, A); turn the lower border inwards for 3 in.; gather the ends together and bring them round the body to the front; tie the ends in front in a vertical line from the left shoulder. The longer end after the knot is tied (which will be in this case the left) is brought vertically upwards and tied to the apex on the top of the left shoulder. (Fig. 102, B).

The Breast-Bone Bandage.—To keep a mustard plaster or a dressing over the breast-bone, fold a triangular bandage or piece of lint, or linen, to form a square; double it and apply over the breast-bone with

the folded border upwards. Pass a narrow triangular bandage beneath the fold (two bandages knotted together may be required), carry the ends one over each shoulder, cross them behind the back and bring them round the sides of the body to the front, where they are pinned to either side of the lower part of the square bandage on the chest (Fig. 103).

Fig. 103.—Breast-bone bandage.

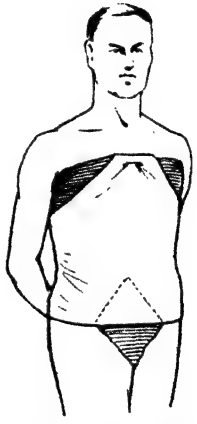


Fig. 104.—Abdominal bandage.

Bandage for Front of the Chest and the Abdomen.—Lay a triangular bandage (open) on the front of the trunk base upwards, gather the ends of the bandage together and bring round the body horizontally below the arm pits, and tie behind. Lay a second triangular bandage (open) on the front of the trunk, with the base at the lower part of the abdomen, tuck the apex over the top of the upper bandage, and pin it there. The ends of the lower bandage are tied behind. Then turn up the apex of the first bandage and pin off (Fig. 104).

Bandage for the Scalp.—To keep a dressing on the top of the head, stand behind the patient, lay a

triangular bandage (open) on the top of the head with the apex at the centre of the neck behind. Turn in the lower border for 2 in. and bring the edge down over the forehead as far as the eyebrows; gather the ends together and carry them round the head just above the ears to the back. Cross the ends over the apex at the back (nape) of the neck, bring them forwards round the head above the ears, and tie them in a knot exactly in the centre and close to the lower border of the bandage. Pull the apex well down behind until the bandage over the scalp is quite smooth; turn up the apex and pin to the bandage on the top of the scalp. (Fig. 105.)

Fig. 105.—Bandage the scalp.

Bandage for the Eye.—To keep a pad or dressing on the eye, say the right, stand in front of the patient; lay the centre of a narrow-fold triangular bandage on the pad or dressing on the eye. Carry one end over the left side of the head at the junction of the top and side to the back; carry the other end downwards below the right ear to the back of the head; here the ends are crossed and made to pass over the centre of the bandage already applied to the front, where the ends are tied over the (right) eye. Care must be taken to prevent the bandage from slipping by keeping the part passing over the head well upwards and not low down on the temple (Fig. 91).

Bandage for Hip or Groin.—To keep a dressing on the back or outside of the hip or on the groin, two bandages are required. Stand or kneel facing the hip to be bandaged, pass a narrow-fold triangular bandage round the body with its centre at the opposite hip, and tie the ends on the outer side of the hip to be bandaged. The bandage should encircle the body between the margins of the haunch-bones and the upper

ends of the thigh bones (femora), where they form the trochanters. The second bandage—a triangular bandage (open)—is laid on the hip with its apex upwards. The apex is passed beneath the first applied bandage at the point where the knot occurs, and drawn through for a distance of 4 in. The lower border (base) of the bandage is turned inwards for 2 in., the ends gathered up and passed horizontally round the thigh, and again brought round 1 in. above the lower edge of the bandage, and tied on the outer aspect of the thigh. The apex is pulled so that the bandage lies smoothly, is turned down over the knot and pinned to the bandage on the outer aspect of the hip. When the back of the hip has to be covered, the knot in the narrow-fold bandage is farther back, and the whole of the bandage over the hip is carried backwards; when the groin is to be covered the knot is farther forwards, and the bandage over the hip moved to the front. (Fig. 106.)

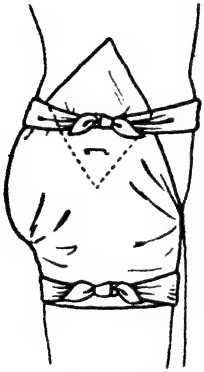


Fig. 106.—Bandage for the hip or groin

Bandage for the Knee.—Lay a triangular bandage open on the front of the knee to be covered so that its apex is at the centre of the front of the thigh. Turn in the lower border for about 2 in.; gather the ends together, carry them backwards and upwards behind the knee-joint, bring them forwards and tie them 4 in. above the knee-cap on the front of the thigh. Pull the apex until the bandage is taut, fold it down over the knot, and pin it to the bandage over the front of the knee (Fig. 108).

Bandage for the Whole Foot.—To keep a dressing or poultice on the foot, lay a triangular bandage open on the floor (a newspaper or other clean material should be laid on the floor to prevent the bandage from getting soiled) with the apex away from the patient; place the foot flat on the bandage with the

toes pointing towards the apex and the heel 4 in. from the lower border (base). Bring the point upwards over the dorsum (back or upper aspect) of the foot and the front of the ankle to the front of the lower part of the leg; gather the ends together, cross them over the dorsum of the foot, and carry them behind the ankle, where they are crossed, and then brought forward and tied at the front just over the ankle. The apex is now pulled upon until the bandage is taut, and folded downwards to cover the knot and pinned to the bandage on the dorsum (Fig. 108). If the bandage is sufficiently long, instead of tying the ends on the dorsum of the foot, they may be crossed over the upper surface of the foot and tied beneath on the sole of the foot; by this means the bandage is more securely fixed.

When applying the bandage the base will be found to enclose the heel behind, and as the ends are carried round the ankle there should be no gap left between the base and the bandage ends going round the ankle.

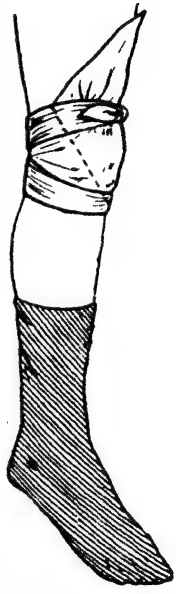


Fig. 107.—Bandage for the knee.

To Cover the Heel.—To keep a dressing on the heel, lay a triangular bandage open flat on the floor (protected as above from being soiled) with the apex backwards and the base forwards; place the patient's foot on the bandage so that the base of the bandage corresponds to the balls of the toes: bring the apex upwards behind the heel and leg; gather the ends together, cross them over the dorsum (back or upper aspect) of the foot and carry them backwards round the ankle, where they are crossed and brought forward round the lower part of the leg (once or twice, according to the length of bandage available), and finally carried

to the back of the leg just above the ankle, where they are tied. The apex is now pulled so as to render the bandage taut, when it is brought down over the knot and pinned to the bandage behind (Fig. 109). Instead of the ends being tied behind and above the heel, they may be brought forwards, after encircling the lower part of the leg, crossed in front of the ankle, and tied on the under aspect (sole) of the foot.

Fig. 108.—Bandage for the foot.

Fig. 109.—Bandage for the heel.

Bandage for the Ankle.—In the case of a sprain or other injury to the ankle, place the centre of a narrow-fold bandage on the middle of the sole of the foot; bring the ends upwards, cross them on the dorsum (back or upper aspect) of the foot close to the front of the ankle, carry them round the ankle to the back, cross them behind, bring them forward round the ankle to the front, cross them again and carry them to the sole of the foot, where they are tied; or, instead of tying them on the sole of the foot, the ends may be made to encircle the ankle once or twice and the knot tied where convenient.

CHAPTER XVI

TRANSPORT OF INJURED PERSONS

SYSTEMATIC instruction and drill for transport of the sick and injured by hand seats, by stretcher, by wheeled vehicles, rail, &c., are given in No. 3 of the

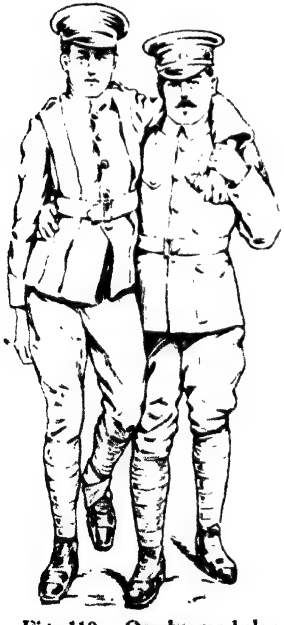


Fig. 110.—One-bearer help: sprained left ankle.

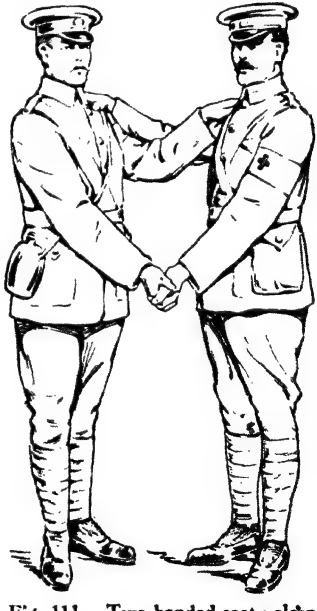


Fig. 111.—Two-handed seat: clasp-handgrip with hands on shoulders.

British Red Cross Society's manuals. In this volume (No. 1) a few improvised methods only are described, and a few directions given for loading, lifting and lowering stretchers.

1. **One Bearer.**—The patient may be carried "pick-

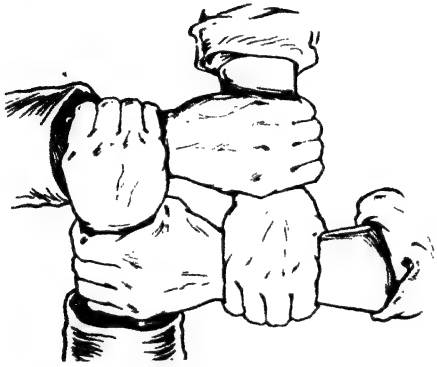


Fig. 112.—Four-handed seat.

a-back" or by fireman's lift (p. 153) when the injury or ailment allows of this being done; or he may be helped if the ankle is sprained or the lower limb otherwise injured as shown in Fig. 110.

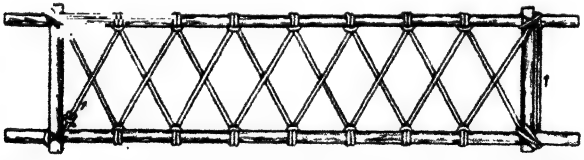


Fig. 113.—Stretcher consisting of poles, cross-bars, and rope.

2. **Two Bearers.**—Hand seats may be formed in various ways—e.g. (*a*) a two-handed seat with support for the back (Fig. 111), (*b*) a four-handed seat (Fig. 112).

3. **Stretchers.**—An improvised stretcher can be formed of (*a*) a couple of poles 7 ft. long, cross-bars to

keep, poles apart, and a rope (Fig. 113); (*b*) a couple of poles passed through the inverted sleeves of two or three jackets, or two jackets and a waistcoat (Fig. 114); (*c*) a door (Fig. 115).

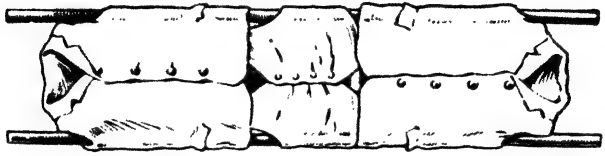


Fig. 114.—Stretcher made by passing poles through inverted sleeves.

4. Chairs.—How a chair may be used for carrying purposes may be seen by glancing at Fig. 116.

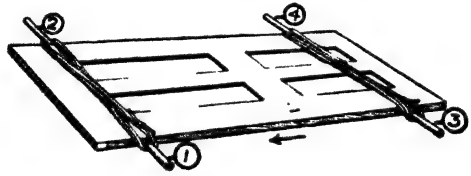


Fig. 115.—Door as stretcher, four bearers.

To Place a Patient on a Stretcher. (Four Bearers)

Number the bearers 1, 2, 3 and 4. No. 4 is in charge, and gives the word of command. In selecting the bearers, No. 3 should be the tallest.

The words of command are printed in heavy type.

"Load Stretcher."—When the patient is ready for removal on the stretcher, No. 4 gives the command "Load Stretcher," when the bearers place themselves as follows: Nos. 1, 2, and 3 on the left of the patient, No. 4 on the right; No. 1 at the knees, No. 2 at the hips, No. 3 at the shoulders, No. 4 on the patient's right opposite No. 2 (Fig. 117).

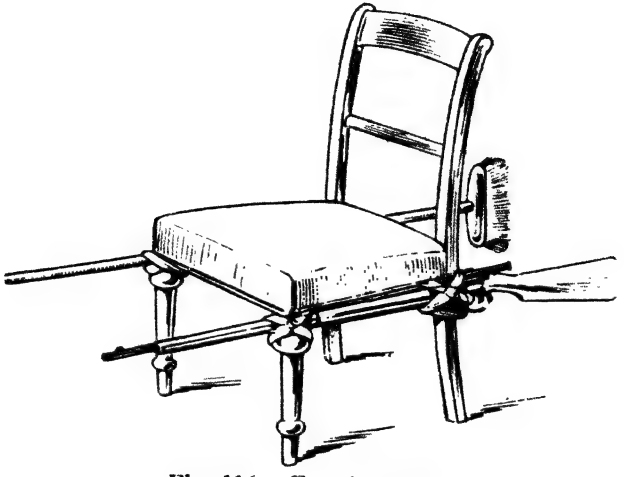


Fig. 116.—Carrying-chair.

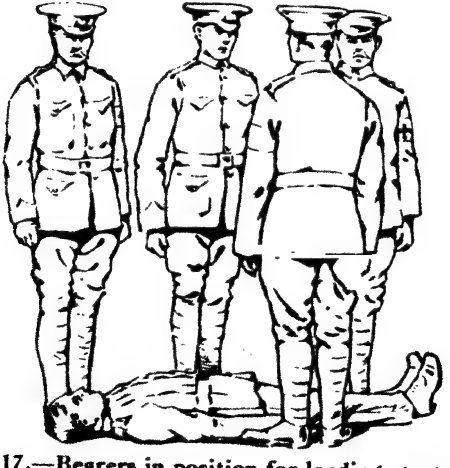


Fig. 117.—Bearers in position for loading stretcher.

The whole turn towards the patient and, kneeling on the left knee, pass their hands beneath the patient; No. 1 supports the legs, No. 2 the thighs and hips, No. 3 the upper part of the trunk and head, No. 4 on the right assisting to lift by passing his hands beneath the patient

Fig. 118.—Bearers kneeling to lift the patient.

Fig. 119.—Patient lifted on the knees of Nos. 1, 2, 3.

in corresponding position to No. 2 (Fig. 118). In lifting the patient off the ground, special care must be taken of the injured part, No. 4 giving the necessary instructions for carrying out this precaution.

In the case of a severe injury, No. 4 attends to the injured part in lifting.

"**Lift.**"—No. 4 now gives the command "Lift,"

when the patient is carefully lifted on to the knees of Nos. 1, 2 and 3 (Fig. 119). No. 4 on the right of the patient disengages, rises, doubles to the stretcher, returns to the patient and places the stretcher directly beneath him. No. 4 now kneels on his left knee and assists in lowering the patient.

"**Lower.**"—No. 4 giving the command "Lower,"

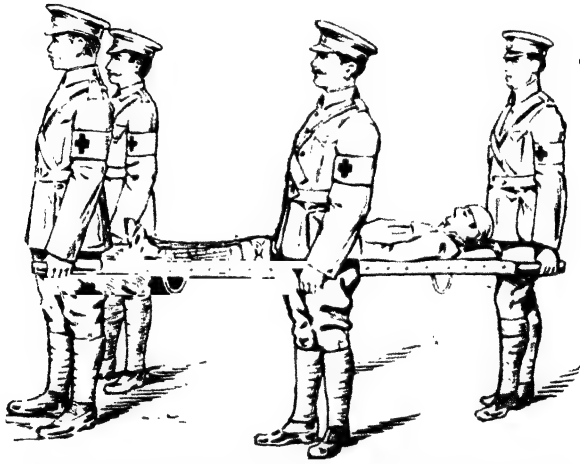


Fig. 120.—**Position of bearers carrying loaded stetcher.**

the patient is lowered slowly and gently on to the centre of the canvas, special care being taken of the injured part.

When the patient is laid on the stretcher, the bearers disengage, rise, Nos. 1, 2 and 3 turn to the left, No. 4 to the right. The bearers stand facing in the same direction as the patient's feet, the foot of the stretcher.

Lifting and Lowering Loaded Stretcher

"**Lift Stretcher.**"—When the patient is on the stretcher, No. 4 gives the command; No. 1 takes post between the handles at the foot of the stretcher. No. 3

between the handles at the head; both stoop and raise the stretcher gently. Care must be taken that the patient's feet are not raised above the level of his head. No. 2 places himself at the centre of the left of the stretcher, and No. 4 in line with No. 1 on No. 1's right (Fig. 120).

In marching, Nos. 1, 2, and 4 start off with the left foot, and No. 3 with the right. The "broken step" prevents a swing on the stretcher. Nos. 1 and 3 keep their knees bent, and raise their feet as little as possible, to prevent jolting.

"**Halt.**" — The bearers halt without jolting the stretcher.

"**Lower Stretcher.**"—Nos. 1 and 3 stoop slowly and place the stretcher gently on the ground. The bearers then "fall in" to the stretcher, Nos. 1, 2 and 3 on left, No. 4 on the right, all facing towards the foot of the stretcher.

Unloading Stretcher

Proceed as when lifting the patient for loading the stretcher. The words of command are—

"**Unload Stretcher.**"—The bearers place themselves as described for loading, Nos. 1, 2, 3 on the left, and No. 4 on the right opposite No. 2 (Fig. 117).

"**Lift.**"—The patient is lifted on to the bearers' knees as for loading (Figs. 118 and 119). No. 4 then removes the stretcher, and assists No. 2 to "lower" the patient to the ground; or all may stand up, and, taking side paces, place the patient on a bed, or cart, or other vehicle, for transport.

Slings for short distance carrying are unnecessary. Voluntary Aid Detachment slings are worn under the coat when in uniform (*see* Manual No. 3).

APPENDIX

RED CROSS FIRST AID AND NURSING CERTIFICATES

1. By the War Office requirements all candidates for Men's Voluntary Aid Detachments, with the exception of pharmacists, ex-soldiers Royal Army Medical Corps (Regular, Special Reserve, or Territorial), ex-sick berth attendants Royal Navy, persons who hold the certificate of the Medico-Psychological Association for Great Britain and Ireland, cooks and carpenters (the two latter not to exceed four and two respectively per detachment), should be in possession of a First Aid Certificate, or undertake to produce such certificate within 12 months from the date of enrolment. Should they fail to do so they will be liable to be removed from the detachment.

2. All candidates for Women's Voluntary Aid Detachments, with the exception of trained nurses, persons who hold the certificate of the Medico-Psychological Association for Great Britain and Ireland, and cooks (cooks not to exceed four per detachment), should be in possession of both a First Aid and a Home Nursing Certificate, or undertake to produce such certificates within 12 months from the date of enrolment, otherwise they are liable to be removed from the detachment.

3. The War Office having approved the certificates both in First Aid and in Nursing granted by the Society, any Branch of the British Red Cross Society desiring to hold classes and examinations in the above subjects should adopt the procedure laid down in the following paragraphs.

4. The Branch should form its own class in First Aid or Home Nursing, and make arrangements for the conduct of the examination at the end of the course.

5. The instruction in First Aid or in Home Nursing must be given in accordance with the syllabus detailed hereunder.

6. The names and addresses of the proposed Lecturers (Instructors of Classes) and Examiners must be submitted through the County Red Cross Branch to the Central

Facsimile (reduced) of the British Red Cross Society's First Aid Certificate.

Facsimile (reduced) of the British Red Cross Society's Home Nursing Certificate.

Executive Committee for approval. A list will be kept at the Central Office of all approved Lecturers and Examiners.

7. The course of instruction in First Aid must be given by a duly qualified medical practitioner, and the examination must be carried out by a qualified medical practitioner other than the instructor of the class.

8. The instruction in Home Nursing must be carried out either by a duly qualified medical practitioner or by a trained nurse, as may be found most convenient. The examination, however, must be conducted either by a qualified medical practitioner, by a matron of a Nurse Training School, or by the County Superintendent of Queen Victoria's Jubilee Institute for Nurses, either of whom must be distinct from the instructor of the class.

9. The Army Council has extended the definition of a matron of a training school as laid down in paragraph 12 of the "Scheme" to mean, "a lady actually employed at the time of the examination as a matron of any hospital, provided she fulfils the requirements necessary for a 'Trained Nurse' as laid down in the second footnote on page 6 of the above-mentioned 'Scheme.'"

10. By the term "trained nurse" is meant a nurse who has completed a three years' course of training in the service of a general hospital having a Nurse Training School attached, and who, having qualified in the examinations of the institution, has received a certificate to this effect.

The minimum number of beds in a general hospital which should be regarded as coming under the term "Nurse Training School," is one hundred.

11. The Society will grant certificates to those who, having attended its courses of instruction, are found on examination to be proficient in the subject or subjects dealt with.

12. The names of those passing the First Aid or Home Nursing Examinations shall be sent to the County Red Cross Secretary, who will then apply to the Secretary, British Red Cross Society, 9, Victoria Street, London, S.W. (using Form D (5) for the purpose), and obtain from him the necessary number of certificates for issue.

13. Should a Branch not hold its own classes in First Aid or in Nursing, certificates of proficiency in these subjects should be obtained from the County Councils or from other

recognised certificate-granting Bodies approved by the War Office.

14. It must be clearly understood that certificates in First Aid and Home Nursing granted by the British Red Cross Society are for the **sole purpose** of entitling the holders to enrolment in a Voluntary Aid Detachment.

The certificates will be issued in the form of a document (in size about 12½ in. by 9¾ in). A facsimile of the First Aid and Nursing certificates will be seen at pages 198 and 199.

RIBBON AND BAR

15. The Society will grant a Ribbon Bar and Pendant as a recognition of Special **proficiency in Red Cross Work** under the following conditions:—

16. The Ribbon Bar and Pendant shall be granted for (i) three successes at **Red Cross First Aid** examinations, provided that an interval of at least twelve months has elapsed between each examination, and subject to the alternative contained in paragraph 18, or (ii) a success at both a **Red Cross First Aid** examination and a **Red Cross Nursing** examination, subject to a third success at a further examination in First Aid or in Nursing held by the Red Cross Society and taken at a period of not less than twelve months from the date of the previous examination. As an alternative the provision contained in paragraph 18 may be adopted.

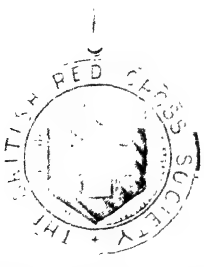
17. Additional Bars shall be granted for each further success at a **Red Cross First Aid** or a **Red Cross Nursing** examination, provided not less than twelve months shall have elapsed between each of such examinations.

18. Members of Red Cross Detachments already holding certificates in **First Aid** or in **Nursing**, acquired from Examining Bodies approved by the War Office, shall be allowed to count one such First Aid certificate and one such Nursing certificate towards a Ribbon Bar and Pendant; the necessary additional certificate or certificates must be obtained after instruction and examination held by the Red Cross Society.

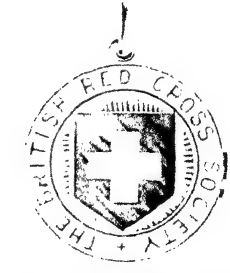
19. The Ribbon shall be white, attached to a gold-gilt enamelled red and white bar and pendant similar in design and colour to the Society's Badge. The Bar shall contain the words "**Proficiency in Red Cross Work.**"

RED CROSS RIBBON AND BAR

Granted for further successes at Red Cross Examinations (p. 201)



Full-size design without additional bar



Full-size design with additional bar

20. Additional Bars granted under paragraph 17 shall bear the year in figures.

21. Ribbons Bars and Pendants shall be issued through the County Branches on the names of those entitled to receive them being added to Form D (5) with particulars of the examination successes.

22. The prices at which Ribbons Bars and Pendants complete, as detailed in paragraph 19, will be issued are as follows :—

Metal gilt . .	1/6 each
Silver . .	4/– ,,
Gold, 9-carat . .	18/– ,,
Gold, 15-carat . .	30/6 ,,
Gold, 18-carat . .	33/6 ,,

ADDITIONAL BARS BEARING THE YEAR IN FIGURES

Metal gilt . .	–/9 each
Silver . .	1/6 ,,
Gold, 9-carat . .	3/6 ,,
Gold, 15-carat . .	4/– ,,
Gold, 18-carat . .	5/6 ,,

23. The **Society's Textbooks** should be used in connection with the subjoined courses, viz.: "First Aid Manual," No. 1, by Colonel James Cantlie, M.A., M.B., F.R.C.S., price 1/–, post free 1/2, and "Nursing Manual," No. 2, by Colonel James Cantlie, M.A., M.B., F.R.C.S., price 1/–, post free 1/2, and may be obtained of the Society.

24. SYLLABUS OF LECTURES ON RED CROSS FIRST AID

LECTURE I

Regions of body.—Head and neck, chest, abdomen, and limbs.

Skeleton.—Bones: composition and general description.

Joints.—How formed, varieties.

Muscular System.—Voluntary and involuntary muscles.

Digestive System.—Position and functions of organs.

Respiratory System.—Position and functions of lungs.

Lymphatics or Absorbents.—Bearing on blood poisoning.

Excretory Organs.—The part played by the intestines, lungs, kidneys, and skin.

Wounds and Bruises.—First Aid treatment of same.

Practical training in the use of the triangular and roller bandages.

The forming of hand seats.

LECTURE 2

Sprains—their treatment. Dislocations—description and treatment. Fractures—how caused, varieties, diagnosis from dislocations, dangers of unskilled help. First Aid treatment of fractures—treatment to be confined to immediate relief. Gunshot injuries. Improvising splints.

Practical training in the use of the triangular and roller bandages.

The fireman's lift.

LECTURE 3

General description of circulation of blood and mechanism by which it is carried on. The heart. The pulse. External hæmorrhage—difference between arterial, venous and capillary, and general treatment of hæmorrhage. Arrest of hæmorrhage from (1) the armpit; (2) the forearm and hand; (3) the thigh; (4) the ham; (5) the leg; (6) the foot; (7) the head and neck. First Aid in (1) bleeding from the nose; (2) spitting of blood; (3) vomiting blood. Internal hæmorrhage—arrest of hæmorrhage from ruptured varicose vein, and socket of (extracted) tooth.

Practical training in the use of the triangular and roller bandages.

Description of stretchers.

LECTURE 4

Respiration — objects and mechanism. Suffocation or Asphyxia—causes and effects; immediate First Aid treatment in cases of: (1) apparently drowned; (2) suffocation by (*a*) hanging, (*b*) poisonous gases or smoke, (*c*) choking, (*d*) scalds and stings of mouth or throat. Sylvester's, Schäfer's, Howard's, Laborde's methods of artificial respiration. A short account of the nervous system; common affections of nervous system and their relief; concussion and compression of brain, apoplexy, epilepsy, bites from animals; sunstroke; shock or collapse.

Practical training in the use of the triangular and roller bandages.

Stretcher practice.

LECTURE 5

Treatment of burns and scalds, frost-bite, burns by electricity and First Aid in electric shock. Treatment of foreign bodies in the throat, ear, stomach, nose and eye. What to do when the dress catches fire. The management of clothes in street accidents. General treatment of cases of poisoning. Preparation of the bed and bedroom in case of accidents.

Practical training in the use of the triangular and roller bandages.

Stretcher practice and improvisation of stretchers.

25. SYLLABUS OF LECTURES ON RED CROSS NURSING.

LECTURE 1

Accommodation for sick persons. Ward, room or tent. Sunlight and aspect. Space required. Estimation of cubic air capacity. Ventilation—Bird, Louvre and Tobin methods. Evils of insufficient ventilation. Emptying, dusting, and washing room. Heating and management of fire. Position of bed. Bedding, blankets, &c. Practical training in the use of the roller bandage.

LECTURE 2

Infectious cases. How infection is spread. Value of isolation. General course of infectious fevers. Stages through which they pass. Quarantine. Management and nursing of typhoid fever. Care in convalescence. Disinfection of patient, clothes, and room, according as room is occupied or unoccupied. General observations on nursing in the open, in temporary shelters, in ambulance trains. Practical training in the use of the roller bandage.

LECTURE 3

Taking pulse, respirations and temperature. Clinical thermometers and charts. Filling in charts. Meaning of variations in temperature. Making beds. Changing sheets. Draw sheet. Fracture bed. Warming beds. Bed rests and cradles—means of improvising. Practical instructions in bed making, changing sheets, &c. Practical training in the use of the roller bandage.

LECTURE 4

The nurse—dress, duties, and rest. Changing patient's night-dress. Washing and sponging patients. Feeding patients—exact details of amounts, kind, and times of feeding to be followed. How different food are to be given. Feeding cups. Utensils and their cleanliness. Digestion of food in mouth, stomach, and intestine. Absorption and excretion. Practical training in the use of the roller bandage.

LECTURE 5

Administration of medicines. Medicine glasses. How to give pills, powders, oil, etc. Administration of enemata. Application of hot fomentations, poultices, blisters, and leeches. Baths — cold, tepid, warm, and hot, and their effects. Stimulants. Practical training in the use of the roller bandage.

LECTURE 6

Keeping record of patient as to sleep, rest, coughing, vomiting, delirium, action of skin, amount and character of excretions. Dressing wounds. Bed-sores.

Practical details of making—beef tea, chicken tea, raw meat juice, and suitable drinks. Convalescence. Practical training in the use of the roller bandage.

26. Lecturers are reminded that each lesson is to be made as practical and as elementary as possible, and that a non-technical graphic treatment of the subject is essential.

27. In instructing these classes the object must be to show how things that are ready to hand may be utilised in any emergency. The pupils should be taught to adapt their methods to their surroundings, to utilise domestic appliances, and to make the best of what lies to hand.

28. Candidates for Red Cross examinations should not be under 17 years of age.

29. The following instructional equipment is suitable for use in connection with the Red Cross First Aid and Nursing courses respectively, and can be obtained from the Society at the prices hereunder quoted. A remittance should in all cases accompany the order.

30. RED CROSS FIRST AID INSTRUCTIONAL EQUIPMENT

All the following equipment is of British manufacture :—

		PRICE. £	s.	d.
1. Stretcher, British Red Cross (closing) pattern, as follows :—	each	1	5	0
Length { Ash poles ... 7 ft. 9 in. Brown canvas ... 6 ,, — ,,				
Width, total... ... ... 1 ,, 11 ,,				
Height ... ... — ,, 6 ,,				
2 Folding ironwork traverses.				
4 Ironwork loop legs.				
Slings for stretcher, webbing... ...pair		0	4	0
Two rope handles fitted to middle of stretcher for two extra bearers ...pair		0	1	6
Two iron handles fitted to middle of stretcher for two extra bearers ...pair		0	1	0
2. Large set of 6 (mounted on linen and rollers) Diagrams on First Aid as adopted by the Admiralty and War Office :—				
Human Skeleton—Bones and joints				
Heart and circulation of the blood				
Hæmorrhage — Digital compression of arteries	Per set	0	18	6
Hæmorrhage and wounds—Compression of arteries by tourniquets, forced flexion, &c.				
Dislocations and fractures ...				
Fractures—Treatment of ...				
3. Bandages, Triangular (per doz. 3/-)	each	0	0	3½
do. do. illustrated (per doz. 3/6)	each	0	0	4
4. Do. Roller, 2½ in. (per doz. 2/-)	each	0	0	2½
5. Splint, Liston's Thigh, not jointed, 48 in. ... ...each		0	1	3

		PRICE		
		£	s.	d.
6. Splints (common), suitable for— (*a*) Arm (*d*) Finger ... (*b*) Forearm (*e*) Large Thigh (*c*) Small Thigh (*f*) Leg... ...	Per set	0	3	0
7. Bandage Winder (Tunstall's)	...each	0	2	0
8. Tow for padding splints ...	per lb.	0	0	4
9. First Field Dressing, latest authorised Army Pattern (Nov. 1911) ...	...each	0	0	8½
10. Field Tourniquet, Army Pattern consisting of a strong web with buckle and cork pad...	...each	0	1	0
11. Red Cross First Aid Manual, by Colonel James Cantlie, M.A., M.B., F.R.C.S., the official Textbook for the Red Cross First Aid Course Price 1/- ; post free		0	1	2

Goods, except Manuals, to the value of 5/- will be forwarded carriage paid.

31. RED CROSS NURSING INSTRUCTIONAL EQUIPMENT

All the following equipment is of British manufacture :—		PRICE. £	s.	d.
1. Bandages, Roller (per doz. 2/-)	...each	0	0	2½
2. Bandage Winder Tunstall's)...	...each	0	2	0
3. Fluid Measure Glass, graduated in minims, drachms, and ounces	...each	0	0	10
4. Clinical Thermometer, lens front	...each	0	1	0
5. Sick-room Thermometer ...	...each	0	0	9
6. Bath Thermometer	...each	0	0	7
7. Temperature (Sick-room) Charts	per doz.	0	0	3
8. Plain Gauze for poultices (6 yds., 8d.)	per yd.	0	0	1½
9. Red Cross Nursing Manual, by Colonel James Cantlie, M.A., M.B., F.R.C.S., the official Textbook for the Red Cross Nursing Course Price 1/- : post free		0	1	2

Goods, except Manuals, to the value of 5/- will be forwarded carriage paid.

32. Sets of instructional equipment suitable for use at each course of lectures may be hired of the Society at a charge, including carriage, as follows :—

33. HIRE OF RED CROSS FIRST AID INSTRUCTIONAL EQUIPMENT

1. The equipment enumerated in the following list can be obtained from the Society on hire (eight weeks) (carriage paid) for a single course of lectures at a charge of 21/3; or
2. The same equipment, without stretcher, can be hired for a similar period (carriage paid) at a charge of 15/3; or
3. The set of six large First Aid diagrams for the lecturer's use at a single course (eight weeks) may be hired (carriage paid) for an inclusive charge of 5/-.

(*a*) Stretcher, Red Cross (closing) Pattern.

(*b*) Large set of 6 (mounted on linen and rollers) Diagrams on First Aid as adopted by the Admiralty and War Office :—

- Human Skeleton—Bones and joints.
- Heart and circulation of the blood.
- Hæmorrhage—Digital compression of arteries.
- Hæmorrhage and Wounds—Compression of arteries by tourniquets, forced flexion, &c.
- Dislocations and fractures.
- Fracture—Treatment of.

(*c*) 1 Bandage Winder.

(*d*) 1 Liston's Thigh Splint.

(*e*) 1 Set Common Splints, suitable for—

(*a*) Arm. (*d*) Finger.
(*b*) Forearm. (*e*) Large Thigh.
(*c*) Small Thigh. (*f*) Leg.

(*f*) Field Tourniquet, Army Pattern, consisting of a strong web with buckle and cork pad

Together with the following articles, which may be retained :—

(*g*) 12 Triangular Bandages.

(*h*) 12 Roller Bandages, $2\frac{1}{2}$ in.

(*i*) 1 lb. of Tow for padding splints.
(*j*) First Field Dressing, latest authorised Army Pattern (Nov. 1911).

34. HIRE OF RED CROSS NURSING INSTRUCTIONAL EQUIPMENT

The equipment enumerated in the following list can be obtained from the Society on hire, carriage paid, for a single course of lectures (eight weeks) at a charge of 6/6.

(*a*) 1 Bandage Winder.
(*b*) 1 Fluid Glass Measure, graduated in minims, drachms, and ounces.
(*c*) 1 Clinical Thermometer, lens front.
(*d*) 1 Sick-room Thermometer.
(*e*) 1 Bath Thermometer.

Together with the following articles, which may be retained :—

(*f*) 12 Roller Bandages, 2½ in.
(*g*) Temperature (Sick-room) Charts.
(*h*) Plain Gauze for poultices.

35. *It is important to note that equipment must be returned from hire (carriage paid) complete and undamaged, with the exception of those articles which may be retained. A charge will be made for any article soiled or returned damaged.*

36. A detailed price list of Red Cross appliances, which may be obtained from the Society, can be had on application to the Secretary, 9, Victoria Street, London, W.

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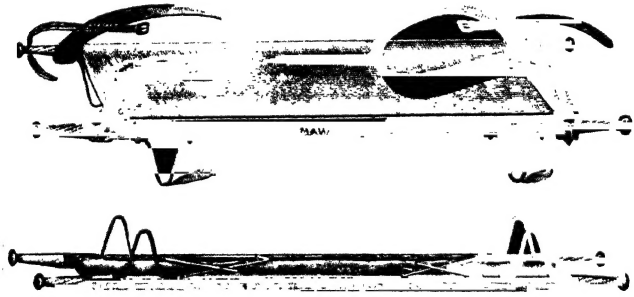
INSTRUCTIONAL EQUIPMENT
:: OF EVERY DESCRIPTION ::



Hand Stretcher (latest pattern). Webbing Slings. Iron or Rope Side Handles for extra bearers. Knee Pads for Stretcher Drill.

FOR PARTICULARS AND PRICES
APPLY TO

THE BRITISH RED CROSS
SOCIETY,

9 VICTORIA STREET, LONDON, S.W.